EXHIBIT 14

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PANEL DATA ESTIMATES OF THE PRODUCTION FUNCTION AND PRODUCT AND LABOR MARKET IMPERFECTIONS

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SUMMARY

Consistent with two models of imperfect competition in the labor market—the efficient bargaining model and the monopsony model—we provide two extensions of a microeconomic version of Hall's framework for estimating price-cost margins. We show that both product and labor market imperfections generate a wedge between factor elasticities in the production function and their corresponding shares in revenue, which can be characterized by a 'joint market imperfections parameter'. Using an unbalanced panel of 10,646 French firms in 38 manufacturing industries over the period 1978–2001, we can classify these industries into six different regimes depending on the type of competition in the product and the labor market. By far the most predominant regime is one of imperfect competition in the product market and efficient bargaining in the labor market (IC-EB), followed by a regime of imperfect competition in the product market and perfect competition or right-to-manage bargaining in the labor market (IC-PR), and by a regime of perfect competition in the product market and monopsony in the labor market (PC-MO). For each of these three predominant regimes, we assess within-regime firm differences in the estimated average price-cost mark-up and rent sharing or labor supply elasticity parameters, following the Swamy methodology to determine the degree of true firm dispersion. To assess the plausibility of our findings in the case of the dominant regime (IC-EB), we also relate our industry and firm-level estimates of price-cost mark-up and extent of rent sharing to industry characteristics and firm-specific variables respectively.

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1. INTRODUCTION

In a world of perfect competition, the output contribution of individual production factors equals their respective revenue shares. In numerous markets, however, market imperfections and distortions are prevalent. The most common sources for market power in product markets are product differentiation, barriers to entry and imperfect information. The sources of market power are similar in labor markets. The labor economics literature is currently dominated by rent-sharing models where, for example, costs of hiring, firing and training can be exploited by *employees* to gain market power. Those models generate wage differentials that are unrelated to productivity differentials and hinder the competitive market mechanism. Recently, however, the monopsony model has regained considerable attention. In this model, contrary to the standard rent-sharing models, search frictions or heterogeneous worker preferences for job characteristics generate upward-sloping labor supply curves to individual firms, thus giving some market power to *employers*.

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Since the 1970s, models of imperfect competition have *separately* permeated many fields of economics ranging from industrial organization (see Bresnahan, 1989, and Schmalensee, 1989, for surveys) to international trade (e.g. Krugman, 1979; Brander and Spencer, 1985) and to labor economics (see Booth, 1995, and Manning, 2003, for surveys). In recent years, there have been a small number of studies that *simultaneously* consider imperfections in the product and the labor market (Bughin, 1996; Crépon *et al*., 1999, 2005; Dobbelaere, 2004; Dumont *et al*., 2006; Neven *et al*., 2006; Abraham *et al*., 2009; Boulhol *et al*., 2011).[1] By estimating jointly price-cost mark-ups in the product market and the extent of rent sharing in the labor market, these studies contribute to bridging the gap between the econometric literature on product market imperfections and that on labor market imperfections. They basically follow two closely related but distinct approaches: one entailing the estimation of a structural model with a full set of explicitly specified factor share equations and the production function; the other extending Hall's (1988) framework and relying more simply on the estimation of a reduced-form equation. Taking this second approach and using a large panel data sample of French manufacturing firms, this paper generalizes our previous, own work and provides a detailed analysis of product and labor market imperfections as two major sources of discrepancies between input factor prices and marginal productivities at both the industry and the firm level. It thus also contributes to the econometric literature on estimating microeconomic production functions with firm panel data.[2]

We consider two extensions of Hall (1988), respectively consistent with a standard collective bargaining model and a firm monopsony model in the labor market. The first follows Crépon *et al.* (1999, 2005) and presumes that employees possess a degree of market power when negotiating with the firm over wages and employment (efficient bargaining model; McDonald and Solow, 1981). The second abstains from the assumption that the labor supply curve facing an individual employer is perfectly elastic (monopsony model; Manning, 2003). By comparing the factor elasticities for labor and materials as directly estimated in firm production functions with their revenue shares, we obtain an estimate of a parameter ψ of joint market imperfections. Depending on the sign and statistical significance of this estimate, we can test whether the efficient bargaining model or the monopsony model prevails, and hence derive estimates of the price-cost mark-up and extent of rent-sharing parameters μ and ϕ in the first case, or the price-cost mark-up and labor supply elasticity parameters μ and ε_w^N in the second case.

We use an unbalanced panel of 10,646 French firms in 38 manufacturing industries over the period 1978–2001 to estimate a standard Cobb-Douglas production function for each of these 38 industries. From the estimated industry-specific output elasticities for labor and materials and from their average revenue shares, we derive the industry-specific joint market imperfections parameter ψ_j. Based on its sign and statistical significance, we classify industries in distinct regimes that differ in terms of the type of competition prevailing in both markets. We thus distinguish six regimes:

1. Perfect competition in the product market and perfect competition or right-to-manage bargaining in the labor market, denoted PC-PR.
2. Imperfect competition in the product market and perfect competition or right-to-manage bargaining in the labor market, denoted IC-PR.
3. Perfect competition in the product market and efficient bargaining in the labor market, denoted PC-EB.
4. Perfect competition in the product market and monopsony in the labor market, denoted PC-MO.

[1] For *theoretical* contributions on this issue, we refer to Nickell (1999) and Blanchard and Giavazzi (2003).
[2] For a survey of this literature, see Griliches and Mairesse (1998) and Ackerberg *et al*. (2007).

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5. Imperfect competition in the product market and efficient bargaining in the labor market, denoted IC-EB.
6. Imperfect competition in the product market and monopsony in the labor market, denoted IC-MO.

IC-EB is by far the dominant regime, followed by IC-PR and PC-MO. For each of these regimes separately, we do not only consider industry differences in the estimated labor and materials output elasticities and shares and in the estimated product and labor market imperfection parameters, but also investigate the underlying firm-level differences in these various parameters. Following Mairesse and Griliches (1990), we adopt a random coefficient framework and use the Swamy (1970) variance decomposition approach to determine the degree of true firm dispersion. Finally, as a way to assess the plausibility of our findings in the case of the dominant regime (IC-EB), we also relate our industry and firm-level estimates of price-cost mark-up and extent of rent sharing to industry characteristics and firm-specific variables respectively.

Our analysis is most closely related to Mairesse and Griliches (1990), Crépon *et al*. (1999, 2005) and Dobbelaere (2004). Using a sample of manufacturing firms in France, the USA and Japan, Mairesse and Griliches (1990) estimate the true dispersion in the output-capital coefficient of a production function in the three countries. Using a sample of manufacturing firms in France, Crépon *et al*. (1999, 2005) estimate a Solow residual equation that gives estimates of average price-cost mark-up and average rent-sharing parameters at the manufacturing level. Using a sample of manufacturing firms in Belgium, Dobbelaere (2004) also uses the Solow residual normalization to analyze industry differences in estimated average price-cost mark-up and rent-sharing parameters. The present study goes further than our previous analyses in four respects. First, instead of estimating a total factor productivity equation, we prefer in a first step to estimate directly the production function and in a second step to derive the product and labor market imperfection parameters. Second, we do not impose *a priori* the efficient bargaining framework upon the data but we classify industries based on the type of competition prevailing in the product and the labor market. Third, we examine how the industry estimates of the market imperfection parameters correlate with industry characteristics. Fourth, we also consider the firm-level estimates of the market imperfection parameters and both determine their degree of true dispersion across firms and account partly for such dispersion in terms of a few firm variables.

We proceed as follows. Section 2 explains our theoretical framework and identification strategy. Section 3 presents the data and shows for illustration the estimates of average output elasticities and average market imperfection parameters that we find for manufacturing industries as a whole. In Section 4, we first classify the 38 manufacturing industries in regimes differing in the type of competition that is prevalent in the product and the labor market; we then investigate industry differences in the estimated parameters of interest within the three predominant regimes; and we finally look at the plausibility of such differences in light of a few possibly related industry characteristics in the case of the dominant regime. In Section 5, after recalling the Swamy methodology to decompose an estimated firm parameter variance in a sampling variance and a true variance, we apply it to the firm-level estimates of the market imperfection parameters that we obtain for the three predominant regimes; and we assess their plausibility by relating them to a few firm characteristics in the case of the dominant regime.

2. THEORETICAL AND ECONOMETRIC FRAMEWORK

Hall's (1988) approach for evaluating price-cost mark-ups hinges on one crucial assumption, i.e. firms consider input prices as given prior to deciding their level of inputs. In other words, there is

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no imperfect competition in the labor market. Consistent with two models of imperfect competition in the labor market that are widespread in the literature—the efficient bargaining model and the monopsony model—we reflect on two extensions of Hall's framework. First, following Crépon *et al.* (1999, 2005), we presume that, for example, costs of firing, hiring and training can be exploited by employees to gain market power when negotiating with the firm over wages and employment (efficient bargaining). In this framework, the firm price-cost mark-up and the extent of rent sharing generate a wedge between output elasticities and factor shares. Second, we abstain from the assumption that the labor supply curve facing an individual employer is perfectly elastic (monopsony model). In this setting, the firm price-cost mark-up and the firm wage elasticity of the labor supply curve elicit deviations between marginal products of input factors and input prices.[3] Both extensions of Hall's framework entail estimating a reduced-form equation that allows us to identify the key parameters—measures of product and labor market imperfections—derived from theory.

2.1. Perfect Competition in the Product and the Labor Market

We start from a production function $Q_{it} = \Theta_{it} F(N_{it}, M_{it}, K_{it})$, where i is a firm index, t a time index, N is labor, M is material input, K is capital. $\Theta_{it} = Ae^{\eta_i + u_t + \upsilon_{it}}$, with η_i an unobserved firm-specific effect, u_t a year-specific intercept and υ_{it} a random component, is an index of technical change or 'true' total factor productivity. Denoting the logarithm of Q_{it}, N_{it}, M_{it}, K_{it} and Θ_{it} by q_{it}, n_{it}, m_{it}, k_{it} and θ_{it} respectively, the logarithmic specification of the production function gives

$$q_{it} = (\varepsilon_N^Q)_{it} n_{it} + (\varepsilon_M^Q)_{it} m_{it} + (\varepsilon_K^Q)_{it} k_{it} + \theta_{it} \tag{1}$$

where $(\varepsilon_J^Q)_{it} (J = N, M, K)$ is the elasticity of output with respect to input factor J.

Following Solow (1957), firms act as price takers in product and input markets. In a competitive environment, the firm prices at marginal cost $(C_Q)_{it}$ such that $\frac{P_{it}}{(C_Q)_{it}} = 1$. Assuming that labor and materials are variable input factors, short-run profit maximization implies the following two first-order conditions:

$$(\varepsilon_N^Q)_{it} = (\alpha_N)_{it} \tag{2}$$

$$(\varepsilon_M^Q)_{it} = (\alpha_M)_{it} \tag{3}$$

where $(\alpha_N)_{it} = \frac{w_{it} N_{it}}{P_{it} Q_{it}}$ and $(\alpha_M)_{it} = \frac{j_{it} M_{it}}{P_{it} Q_{it}}$ are the share of labor costs and material costs in total revenue respectively.

Assuming that the elasticity of scale, $\lambda_{it} = (\varepsilon_N^Q)_{it} + (\varepsilon_M^Q)_{it} + (\varepsilon_K^Q)_{it}$, is known, the capital elasticity can be expressed as

$$(\varepsilon_K^Q)_{it} = \lambda_{it} - (\alpha_N)_{it} - (\alpha_M)_{it} \tag{4}$$

Inserting equations (2), (3) and (4) into equation (1) and rearranging terms gives the following expression:

$$q_{it} - k_{it} = (\alpha_N)_{it}[n_{it} - k_{it}] + (\alpha_M)_{it}[m_{it} - k_{it}] + [\lambda_{it} - 1]k_{it} + \theta_{it} \tag{5}$$

[3] One point should be noted. We do not envisage a labor market where there is monopsony *sensu stricto*, i.e. where the employer is the sole employer in the labor market. Instead, the labor market that we have in mind is more accurately described in terms of oligopsony or monopsonistic competition. The former refers to a situation where employer market power persists despite competition with other employers. The latter is equivalent to oligopsony with free entry, driving employers' profits to zero.

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2.2. Imperfect Competition in the Product Market

2.2.1 Perfectly Competitive Labor Market/Right-to-Manage Bargaining

Perfectly Competitive Labor Market. As in the original Hall setting, firms operate under imperfect competition in the product market and act as price takers in the input markets. Short-run profit maximization implies the following two first-order conditions:

$$(\varepsilon_N^Q)_{it} = \mu_{it}\ (\alpha_N)_{it} \tag{6}$$

$$(\varepsilon_M^Q)_{it} = \mu_{it}\ (\alpha_M)_{it} \tag{7}$$

where $\mu_{it} = \dfrac{P_{it}}{(C_Q)_{it}}$ refers to the mark-up of output price P_{it} over marginal cost $(C_Q)_{it}$.[4]

Assuming that the elasticity of scale (λ_{it}) is known, the capital elasticity can be expressed as:

$$(\varepsilon_K^Q)_{it} = \lambda_{it} - \mu_{it}\ (\alpha_N)_{it} - \mu_{it}\ (\alpha_M)_{it} \tag{8}$$

Inserting equations (6), (7) and (8) into equation (1) and rearranging terms gives the following expression:

$$q_{it} - k_{it} = \mu_{it}\ [(\alpha_N)_{it}[n_{it} - k_{it}] + (\alpha_M)_{it}[m_{it} - k_{it}]] + [\lambda_{it} - 1]k_{it} + \theta_{it} \tag{9}$$

Estimating equation (9) allows the identification of the mark-up of price over marginal cost.

Right-to-Manage Bargaining. Let us abstain from the assumption that labor is priced competitively. We assume that the risk-neutral workers and the firm bargain over wages (w) but that the firm retains the right to set employment (N) afterwards unilaterally (right-to-manage bargaining; Nickell and Andrews, 1983). Since, as in the perfectly competitive labor market case, labor and material input are unilaterally determined by the firm from profit maximization (see equations (6) and (7) respectively), the mark-up of price over marginal cost that follows from equation (9) is not only consistent with the assumption that the labor market is perfectly competitive but also with the less restrictive right-to-manage bargaining assumption.

2.2.2 Efficient Bargaining

Each firm operates under imperfect competition in the product market. Following Crépon *et al.* (1999, 2005), we assume that the risk-neutral workers and the firm bargain over wages (w) and employment (N) (efficient bargaining; McDonald and Solow, 1981). It is the objective of the workers to maximize $U(w_{it},\ N_{it}) = N_{it}w_{it} + (\overline{N}_{it} - N_{it})\overline{w}_{it}$, where $\overline{N}_{it}$ is the competitive employment level ($0 < N_{it} \le \overline{N}_{it}$) and $\overline{w}_{it} \le w_{it}$ is the reservation wage. Consistent with capital quasi-fixity, it is the firm's objective to maximize its short-run profit function: $\pi_{it} = R_{it} - w_{it}N_{it} -$

[4] The short-run profit function of an imperfectly competitive firm i at time t is given by $\pi_{it} = P_{it}Q_{it} - w_{it}N_{it} - j_{it}M_{it}$. Profit maximization with respect to labor and materials implies: $(\varepsilon_N^Q)_{it} = \left[1 + \frac{s_{it}\kappa_{it}}{\omega_{it}}\right]^{-1} (\alpha_N)_{it}$ and $(\varepsilon_M^Q)_{it} = \left[1 + \frac{s_{it}\kappa_{it}}{\omega_{it}}\right]^{-1} (\alpha_M)_{it}$ respectively, with s_{it} market share, κ_{it} the conjectural variations parameter (= 1 if firms play Nash in quantities and = 0 if they play Nash in prices) and ω_{it} the price elasticity of demand. Profit maximization with respect to output implies: $\left[1 + \frac{s_{it}\kappa_{it}}{\omega_{it}}\right]^{-1} = \frac{P_{it}}{(C_Q)_{it}} = \mu_{it}$, with P_{it} the output price and $(C_Q)_{it}$ the marginal cost (see Levinsohn, 1993, for details). Substitution leads to equations (6) and (7).

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$j_{it}M_{it}$, where $R_{it} = P_{it}Q_{it}$ stands for total revenue. The outcome of the bargaining is the generalized Nash solution to:

$$\max_{w_{it},\ N_{it},\ M_{it}} \{N_{it}w_{it} + (\overline{N}_{it} - N_{it})\overline{w}_{it} - \overline{N}_{it}\overline{w}_{it}\}^{\phi_{it}}\{R_{it} - w_{it}N_{it} - j_{it}M_{it}\}^{1-\phi_{it}} \tag{10}$$

where $\phi_{it} \in [0, 1]$ represents the absolute extent of rent sharing.

Material input is unilaterally determined by the firm from profit maximization: $(R_M)_{it} = j_{it}$ with $(R_M)_{it}$ the marginal revenue of material input, which directly leads to equation (7).

Maximization with respect to the wage rate and labor respectively gives the following first-order conditions:

$$w_{it} = \overline{w}_{it} + \gamma_{it}\left[\frac{R_{it} - w_{it}N_{it} - j_{it}M_{it}}{N_{it}}\right] \tag{11}$$

$$w_{it} = (R_N)_{it} + \phi_{it}\left[\frac{R_{it} - (R_N)_{it}N_{it} - j_{it}M_{it}}{N_{it}}\right] \tag{12}$$

with $\gamma_{it} = \dfrac{\phi_{it}}{1 - \phi_{it}}$ the relative extent of rent sharing and $(R_N)_{it}$ the marginal revenue of labor.

Solving simultaneously equations (11) and (12) leads to the following expression for the contract curve:

$$(R_N)_{it} = \overline{w}_{it} \tag{13}$$

Equation (13) shows that under risk neutrality, the firm's decision about employment equals that of a (non-bargaining) neoclassical firm that maximizes its short-run profit at the reservation wage.

We denote the marginal revenue by $(R_Q)_{it}$ and the marginal product of labor by $(Q_N)_{it}$. Given that $\mu_{it} = \dfrac{P_{it}}{(R_Q)_{it}}$ in equilibrium, we can express the marginal revenue of labor as $(R_N)_{it} = (R_Q)_{it}\ (Q_N)_{it} = (R_Q)_{it}\ (\varepsilon_N^Q)_{it}\ \dfrac{Q_{it}}{N_{it}} = \dfrac{P_{it}\ (Q_N)_{it}}{\mu_{it}}$. Using this expression together with equation (13), the elasticity of output with respect to labor can be written as:

$$(\varepsilon_N^Q)_{it} = \mu_{it}\ \left(\frac{\overline{w}_{it}N_{it}}{P_{it}Q_{it}}\right) = \mu_{it}\ (\overline{\alpha}_N)_{it} \tag{14}$$

Given that we can rewrite equation (11) as $(\alpha_N)_{it} = (\overline{\alpha}_N)_{it} + \gamma_{it}[1 - (\alpha_N)_{it} - (\alpha_M)_{it}]$, equation (14) is equivalent to

$$(\varepsilon_N^Q)_{it} = \mu_{it}\ (\alpha_N)_{it} - \mu_{it}\gamma_{it}[1 - (\alpha_N)_{it} - (\alpha_M)_{it}] \tag{15}$$

Note that equation (15) discriminates between the right-to-manage bargaining setting and the efficient bargaining setting. In the right-to-manage model, employment is highly endogenous with respect to wages. As in the perfectly competitive labor market case, the marginal revenue of labor is equal to the wage, whereas in the efficient bargaining model employment does not directly depend on the bargained wage. Hence, as discussed in Section 2.2.1, the null hypothesis of $\gamma_{it} = 0$ in equation (15) does not only correspond to the assumption that the labor market is perfectly competitive but also to the less restrictive right-to-manage bargaining assumption.

Assuming that the elasticity of scale, $\lambda_{it} = (\varepsilon_N^Q)_{it} + (\varepsilon_M^Q)_{it} + (\varepsilon_K^Q)_{it}$, is known, the capital elasticity can be expressed as:

$$(\varepsilon_K^Q)_{it} = \lambda_{it} - \mu_{it}\ (\alpha_N)_{it} + \mu_{it}\gamma_{it}[1 - (\alpha_N)_{it} - (\alpha_M)_{it}] - \mu_{it}\ (\alpha_M)_{it} \tag{16}$$

Estimating the production function:

$$q_{it} - k_{it} = (\varepsilon_N^Q)_{it}[n_{it} - k_{it}] + (\varepsilon_M^Q)_{it}[m_{it} - k_{it}] + [\lambda_{it} - 1]k_{it} + \theta_{it} \tag{17}$$

allows us to obtain estimates of (1) the mark-up of price over marginal cost and (2) the extent of rent sharing. From equation (17) it also follows that:

$$\psi_{it} = \frac{(\varepsilon_M^Q)_{it}}{(\alpha_M)_{it}} - \frac{(\varepsilon_N^Q)_{it}}{(\alpha_N)_{it}} = \mu_{it}\gamma_{it}\left[\frac{1 - (\alpha_N)_{it} - (\alpha_M)_{it}}{(\alpha_N)_{it}}\right] \tag{18}$$

to which we refer as the parameter of joint market imperfections in the remainder of the paper, which is positive in this setting.[5]

2.2.3 Monopsony

The model of Hall (1988) is based on the assumption that there is a potentially infinite supply of employees having a free and costless choice of a large number of employers for whom they might work. Competition among these employers then results in a single market wage. A small wage cut by the employer will result in the immediate resignation of all existing workers. In contrast, the wage elasticity of the labor supply curve facing an individual employer is not infinite when the labor market is characterized by monopsony. There are a number of reasons why labor supply might be less than perfectly elastic, creating rents to jobs. Paramount among these are the absence of perfect information on alternative possible jobs (Burdett and Mortensen, 1998), moving costs (Boal and Ransom, 1997) and heterogeneous worker preferences for job characteristics (Bhaskar and To, 1999; Bhaskar *et al*., 2002) on the supply side, and efficiency wages with diseconomies of scale in monitoring (Boal and Ransom, 1997) and entry costs on the part of competing firms on the demand side. All these factors give employers non-negligible market power over their workers.

Consider a firm that operates under imperfect competition in the product market and faces a labor supply $N_{it}(w_{it})$, which is an increasing function of the wage w_{it}. Both $N_{it}(w_{it})$ and the inverse of this relationship $w_{it}(N_{it})$ are referred to as the labor supply curve of the individual firm. The monopsonist firm's objective is to maximize its short-run profit function, taking the labor supply curve as given:

$$\max_{N_{it},\ M_{it}} \pi(w_{it},\ N_{it},\ M_{it}) = R_{it}(N_{it},\ M_{it}) - w_{it}(N_{it})\,N_{it} - j_{it}M_{it} \tag{19}$$

Maximization with respect to material input gives $(R_M)_{it} = j_{it}$, which is equivalent to equation (7).

Maximization with respect to labor gives the following first-order condition:

$$w_{it} = \beta_{it}(R_N)_{it} \tag{20}$$

where $\beta_{it} = \dfrac{(\varepsilon_w^N)_{it}}{1 + (\varepsilon_w^N)_{it}}$ and $(\varepsilon_w^N)_{it} \in \Re_+$ represents the wage elasticity of the labor supply. From equation (20), it follows that the degree of monopsony power, measured by $\frac{(R_N)_{it}}{w_{it}}$, depends negatively on $(\varepsilon_w^N)_{it}$. The more inelastic the labor supply curve to the individual firm, the wider

[5] From equation (18), it is clear that to accommodate two imperfectly competitive markets we need at least two variable input factors to identify the model. Going beyond Hall (1988) is hence not possible when starting from a value-added specification.

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the gap between the marginal revenue of labor and the wage. In the tradition of Pigou (1924) and Hicks (1932), this wedge $\left(\frac{(R_N)_{it} - w_{it}}{w_{it}} = \frac{1}{(\varepsilon_w^N)_{it}}\right)$ is referred to in the literature as the rate of exploitation. Rewriting equation (20) gives the following expression for the elasticity of output with respect to labor:

$$(\varepsilon_N^Q)_{it} = \mu_{it}\ (\alpha_N)_{it}\ \left(1 + \frac{1}{(\varepsilon_w^N)_{it}}\right) \tag{21}$$

Assuming again that the elasticity of scale, $\lambda_{it} = (\varepsilon_N^Q)_{it} + (\varepsilon_M^Q)_{it} + (\varepsilon_K^Q)_{it}$, is known, estimation of the production function $[q_{it} - k_{it} = (\varepsilon_N^Q)_{it}[n_{it} - k_{it}] + (\varepsilon_M^Q)_{it}[m_{it} - k_{it}] + [\lambda_{it} - 1]k_{it} + \theta_{it}]$ allows the identification of (1) the mark-up of price over marginal cost and (2) the labor supply elasticity of the firm. In a monopsony labor market, it thus follows that the parameter of joint market imperfections (ψ_{it}) is expressed as:

$$\psi_{it} = \frac{(\varepsilon_M^Q)_{it}}{(\alpha_M)_{it}} - \frac{(\varepsilon_N^Q)_{it}}{(\alpha_N)_{it}} = -\mu_{it}\frac{1}{(\varepsilon_w^N)_{it}} \tag{22}$$

which is negative in this setting.

2.3. Econometric Identification and Estimation

The data features that are key to empirical identification of the product and labor market imperfection parameters are the differences between the estimated output elasticities of labor and materials and their revenue shares.

Essential is that the test for labor market imperfections takes the materials market as perfectly competitive and compares it to the labor market. In a perfectly competitive labor market or in a right-to-manage bargaining setting, the only source of discrepancy between the estimated output elasticity of labor and the share of labor costs in revenue is the firm price-cost mark-up, just as in the materials market. Therefore, the differences in the two factors' output elasticity-revenue share ratios, i.e. the parameter of joint market imperfections, equals zero.

In an efficient bargaining setting, the marginal employee receives a wage that exceeds his/her marginal revenue since efficient bargaining allocates inframarginal gains across employees. As such, the output elasticity-revenue share ratio for labor becomes smaller, and smaller than the respective ratio for materials in particular. Hence, there is a positive difference between the materials and labor ratios, i.e. the parameter of joint market imperfections is positive, which is what the specification test looks for.

In a monopsony setting, on the other hand, the marginal employee obtains a wage that is less than his/her marginal revenue. As such, the output elasticity-revenue share ratio for labor exceeds the respective ratio for materials, yielding the negative difference (or the negative parameter of joint market imperfections) that the specification test looks for.

Depending on the labor market setting, it follows from the parameter of joint market imperfections that the differences between the estimated output elasticities of labor and materials and their revenue shares can be mapped into either the firm price-cost mark-up and the extent of rent sharing (equation (18)) or the firm price-cost mark-up and the firm labor supply elasticity (equation (22)).

Since our study aims at assessing industry and within-industry (or more precisely within-regime) firm differences in product and labor market imperfection parameters, we estimate *average* parameters. There are many sources of variation in input shares. Some of them are related to variation in hours of work, machinery or capacity utilization (variation in the business cycle). When

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deriving our parameters of interest, we want to abstract from such sources of variation. Therefore, we assume *average* input shares. More precisely, we derive *average* product and labor market imperfection parameters by comparing the estimated *average* production function coefficients, i.e. the estimated average output elasticities of labor and materials, with their *average* input shares. The empirical specification that acts as the bedrock for the regressions in this paper is hence given by:

$$q_{it} - k_{it} = \varepsilon_N^Q[n_{it} - k_{it}] + \varepsilon_M^Q[m_{it} - k_{it}] + [\lambda - 1]k_{it} + \zeta_{it} \quad (23)$$

The estimated joint market imperfections parameter ($\widehat{\psi}$) determines the regime characterizing the type of competition prevailing in the product and the labor market. *A priori*, six distinct regimes are possible: (1) perfect competition in the product market and perfect competition or right-to-manage bargaining in the labor market; (2) imperfect competition in the product market and perfect competition or right-to-manage bargaining in the labor market; (3) perfect competition in the product market and efficient bargaining in the labor market; (4) perfect competition in the product market and monopsony in the labor market; (5) imperfect competition in the product market and efficient bargaining in the labor market; and (6) imperfect competition in the product market and monopsony in the labor market. In the remainder of the paper, we denote the six possible regimes by $R \in \Re = \{$PC-PR, IC-PR, PC-EB, PC-MO, IC-EB, IC-MO$\}$, where the first part reflects the type of competition in the product market and the second part reflects the type of competition in the labor market. Once the regime is determined, we derive the product and labor market imperfection parameters from the estimated joint market imperfections parameter.

Our study considers product and labor market imperfections as two major sources of discrepancies between the output elasticities of labor and materials and their revenue shares. However, we are well aware of the fact that there are other forces, not included in our modeling framework, which might impact our estimated output elasticity-revenue share ratios. Possibilities range from economic factors like distortions in the intermediate materials market, variable factor utilization and factor adjustment costs to measurement issues. We consider addressing/testing empirically these possible sources of discrepancies as a worthy subject for future research but beyond the scope of this paper.

3. DATA DESCRIPTION AND MANUFACTURING-LEVEL RESULTS

In this section, we discuss the data. For illustrative purposes, we also present the results of estimating the production function at the manufacturing level.

3.1. Data Description

We use an unbalanced panel of French manufacturing firms over the period 1978–2001, based mainly on firm accounting information from EAE (Enquête Annuelle d'Entreprise, Service des Etudes et Statistiques Industrielles (SESSI)). We only keep firms for which we have at least 12 years of observations, ending up with an unbalanced panel of 10,646 firms with the number of observations for each firm varying between 12 and 24.[6] We use real current production deflated by the two-digit producer price index of the French industrial classification as a

[6] Putting the number of firms between brackets and the number of observations between square brackets, the structure of the data is given by (1,398) [12], (1,369) [13], (1,403) [14], (1,315) [15], (3,414) [16], (226) [17], (215) [18], (200) [19], (164) [20], (153) [21], (180) [22], (136) [23], (473) [24]. The average number of observations per firm is 15.5 and the total number of observations is 165,009.

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proxy for output (Q). Labor (N) refers to the average number of employees in each firm for each year and material input (M) refers to intermediate consumption deflated by the two-digit intermediate consumption price index. The capital stock (K) is measured by the gross book value of fixed assets.[7] The shares of labor (α_N) and material input (α_M) are constructed by dividing, respectively, the firm total labor cost and undeflated intermediate consumption by the firm undeflated production and by taking the average of these ratios over adjacent years. Table I reports the means, standard deviations and quartile values of our main variables. The average growth rate of real firm output for the overall sample is 2.1% per year over the period 1978–2001. Capital has decreased at an average annual growth rate of 0.1%, while labor and materials have increased at an average annual growth rate of 0.6% and 4% respectively. The Solow residual or the conventional measure of total factor productivity (TFP) is stable over the period. As expected for firm-level data, the dispersion of all these variables is considerable. For example, TFP growth is lower than −5.6% for the first quartile of firms and higher than 5.4% for the upper quartile.

3.2. Manufacturing-Level Results

For illustrative purposes, we estimate the standard production function (equation (23)) at the manufacturing level over the period 1978–2001 with and without imposing constant returns to scale.

Part A of Table II shows the results of estimating equation (23) under the assumption of constant returns to scale ($\lambda = 1$), while Part B allows for non-constant returns to scale. We present both sets of results for a range of estimators. Columns 1 and 2 report the levels ordinary least squares (OLS) estimates and the first-differenced OLS estimates, respectively. From column 3 onwards, we take into account endogeneity problems. Columns 3 and 5 display the results of estimating

Table I. Summary statistics

Variable	1978–2001				
	Mean	SD	Q_1	Q_2	Q_3
Real firm output growth rate Δq	0.021	0.152	−0.061	0.019	0.103
Labor growth rate Δn	0.006	0.123	−0.043	0.000	0.054
Materials growth rate Δm	0.040	0.192	−0.060	0.038	0.139
Capital growth rate Δk	−0.001	0.151	−0.072	−0.020	0.060
Labor share in nominal output α_N	0.307	0.136	0.208	0.291	0.387
Materials share in nominal output α_M	0.503	0.159	0.399	0.510	0.614
$1 - \alpha_N - \alpha_M$	0.185	0.143	0.092	0.158	0.248
$\Delta q - \Delta k$	0.022	0.188	−0.081	0.024	0.126
$\Delta n - \Delta k$	0.007	0.166	−0.073	0.014	0.088
$\Delta m - \Delta k$	0.041	0.220	−0.079	0.041	0.160
SR[a]	0.000	0.100	−0.056	0.000	0.054

Note: Number of observations: 154,363, except for α_N and α_M (165,009).
[a] SR = $\Delta q - \alpha_N \Delta n - \alpha_M \Delta m - (1 - \alpha_N - \alpha_M)\Delta k$.

[7] The capital stock measure used in this paper is the gross book value of tangible assets as reported in the firm balance sheets at the beginning of the year (or at the end of the previous year), adjusted for inflation. This is a standard measure in microeconometric studies of the production function based on firm accounting information. It has the advantage of relying on direct information provided by the firm and does not make the strong assumptions underlying the capital stock measures obtained by the perpetual inventory method, mainly a constant rate of depreciation or a fixed service life. In practice, however, panel data estimates of capital elasticities appear to be very robust to the use of the two types of measures. See, for example, Atkinson and Mairesse (1978) and Mairesse and Pescheux (1980).

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the model in first differences to eliminate unobserved firm-specific effects and using appropriate lags of internal variables in levels (n, m and k) as instruments for the differenced regressors to correct for simultaneity (standard panel first-differenced generalized method of moments (GMM)). As argued by, for example, Blundell and Bond (2000), the first-differenced GMM estimator might be subject to large finite sample biases due to the time series persistence properties of some of the variables. In columns 4 and 6, we therefore adopt a more efficient GMM estimator which includes level moments (system GMM).[8] The last two columns report the results of estimating a dynamic specification of equation (23), allowing for an autoregressive component in the productivity shock.[9]

The first section of each part of Table II gives the estimated output elasticities. The second section presents our key parameters which are derived from the average production function coefficient estimates: the estimated joint market imperfections parameter ($\widehat{\psi}$) from which we infer that the IC-EB-regime applies at the manufacturing level, and the corresponding estimates of the average price-cost mark-up ($\widehat{\mu}$) and the average absolute extent of rent sharing ($\widehat{\phi}$). The

Table II. Estimates of output elasticities $\widehat{\varepsilon}_J^Q (J = N, M, K)$, joint market imperfections parameter ($\widehat{\psi}$), price-cost mark-up $\widehat{\mu}$ (*only*) and absolute extent of rent sharing $\widehat{\phi}$. Full sample: 10,646 firms, each firm between 12 and 24 years of observations; period 1978–2001

Part A: Imposing constant returns to scale: $\widehat{\varepsilon}_K^Q = 1 - \widehat{\varepsilon}_N^Q - \widehat{\varepsilon}_M^Q$

	Static specification				Dynamic specification	
	OLS LEVELS	OLS DIF	GMM DIF $(t-2)(t-3)$	GMM SYS $(t-2)(t-3)$	GMM DIF $(t-2)(t-3)$	GMM SYS $(t-2)(t-3)$
$\widehat{\varepsilon}_N^Q$	0.331	0.298	0.138	0.298	0.134	0.201
	(0.003)	(0.003)	(0.020)	(0.008)	(0.032)	(0.015)
$\widehat{\varepsilon}_M^Q$	0.592	0.587	0.726	0.675	0.595	0.541
	(0.003)	(0.003)	(0.017)	(0.007)	(0.022)	(0.019)
$\widehat{\varepsilon}_K^Q$	0.077	0.115	0.137	0.027	0.271	0.258
λ	1	1	1	1	1	1
$\widehat{\mu}$ only $= \frac{\widehat{\mu}\text{ only}}{\lambda}$	1.144	1.112	1.129	1.211	1.041	0.934
	(0.003)	(0.002)	(0.013)	(0.007)	(0.032)	(0.020)
$\widehat{\psi}$	0.096	0.186	0.993	0.370	0.745	0.421
	(0.017)	(0.013)	(0.095)	(0.036)	(0.128)	(0.071)
$\widehat{\mu} = \frac{\widehat{\mu}}{\lambda}$	1.177	1.167	1.443	1.342	1.184	1.076
	(0.007)	(0.005)	(0.033)	(0.015)	(0.043)	(0.039)
$\widehat{\gamma}$	0.647	0.785	1.628	0.962	1.532	1.146
	(0.017)	(0.013)	(0.063)	(0.030)	(0.116)	(0.069)
$\widehat{\phi}$	0.393	0.440	0.619	0.490	0.605	0.534
	(0.006)	(0.004)	(0.009)	(0.008)	(0.018)	(0.015)
$\widehat{\rho}$					0.713	0.619
					(0.023)	(0.018)

[8] The GMM estimation is carried out in Stata 9.2 (Roodman, 2005). We report results for the *one*-step estimator for which inference based on the asymptotic variance matrix is shown to be more reliable than for the asymptotically more efficient two-step estimator (Arellano and Bond, 1991).

[9] The productivity term is modeled as $\zeta_{it} = \eta_i + u_t + \upsilon_{it}$, with $\upsilon_{it} = \rho\upsilon_{it-1} + e_{it}$, where $|\rho| < 1$, and $e_{it} \sim MA(0)$. η_i is an unobserved firm-specific effect, u_t a year-specific intercept and υ_{it} is an AR(1) error term.

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Table II. (*Continued*)

Part B: Not imposing constant returns to scale: $\widehat{\varepsilon}_K^Q = \widehat{\lambda} - \widehat{\varepsilon}_N^Q - \widehat{\varepsilon}_M^Q$

	Static specification				Dynamic specification	
	OLS LEVELS	OLS DIF	GMM DIF $(t-2)(t-3)$	GMM SYS $(t-2)(t-3)$	GMM DIF $(t-2)(t-3)$	GMM SYS $(t-2)(t-3)$
$\widehat{\varepsilon}_N^Q$	0.331	0.189	0.149	0.240	0.111	0.057
	(0.001)	(0.002)	(0.022)	(0.011)	(0.031)	(0.025)
$\widehat{\varepsilon}_M^Q$	0.592	0.554	0.566	0.696	0.554	0.562
	(0.001)	(0.002)	(0.020)	(0.008)	(0.023)	(0.020)
$\widehat{\varepsilon}_K^Q$	0.077	0.049	−0.027	0.033	0.033	0.241
	(0.002)	(0.003)	(0.038)	(0.017)	(0.057)	(0.027)
$\widehat{\lambda}$	1	0.792	0.688	0.969	0.803	0.860
	(0.0006)	(0.003)	(0.020)	(0.004)	(0.052)	(0.025)
$\widehat{\mu}$ only	1.153	1.011	0.890	1.219	1.011	0.916
	(0.004)	(0.004)	(0.022)	(0.008)	(0.035)	(0.033)
$\frac{\widehat{\mu}\text{ only}}{\widehat{\lambda}}$	1.145	1.189	1.398	1.212	1.074	0.897
	(0.003)	(0.003)	(0.035)	(0.007)	(0.054)	(0.022)
$\widehat{\psi}$	0.100	0.488	0.639	0.602	0.729	0.582
	(0.019)	(0.012)	(0.101)	(0.047)	(0.128)	(0.077)
$\widehat{\mu}$	1.177	1.102	1.126	1.383	1.100	1.117
	(0.002)	(0.004)	(0.039)	(0.016)	(0.046)	(0.041)
$\widehat{\gamma}$	0.652	1.231	1.433	1.219	1.598	1.864
	(0.006)	(0.010)	(0.091)	(0.037)	(0.118)	(0.091)
$\widehat{\phi}$	0.395	0.552	0.589	0.549	0.615	0.651
	(0.002)	(0.002)	(0.015)	(0.007)	(0.017)	(0.011)
$\frac{\widehat{\mu}}{\widehat{\lambda}}$	1.178	1.392	1.637	1.427	1.371	1.299
	(0.002)	(0.006)	(0.055)	(0.020)	(0.088)	(0.057)
$\widehat{\rho}$					0.723	0.609
					(0.023)	(0.020)

Note: Robust standard errors and first-step robust standard errors in columns 1–2 and columns 3–6 respectively. Time dummies are included but not reported.
1. Input shares: $\alpha_N = 0.307$, $\alpha_M = 0.503$, $\alpha_K = 0.190$.
2. GMM DIF: the set of instruments includes the lagged levels of n, m and k dated $(t-2)$ and $(t-3)$.
3. GMM SYS: the set of instruments includes the lagged levels of n, m and k dated $(t-2)$ and $(t-3)$ in the first-differenced equations and the lagged first-differences of n, m and k dated $(t-1)$ in the levels equations.

standard errors (σ) of $\widehat{\mu}$ and $\widehat{\phi}$ are computed using the Delta method (Woolridge, 2002).[10] We also report the profit ratio parameter, which can be expressed as the estimated price-cost mark-up divided by the estimated scale elasticity $\left(\frac{\widehat{\mu}}{\widehat{\lambda}}\right)$. This ratio shows that the source of profit lies either in imperfect competition or decreasing returns to scale. As a benchmark,

[10] More specifically, $\widehat{\mu}$ and $\widehat{\phi}$ are derived as follows: $\widehat{\mu} = \frac{\widehat{\varepsilon}_M^Q}{\alpha_M}$, $\widehat{\gamma} = \frac{\widehat{\varepsilon}_N^Q - \left(\widehat{\varepsilon}_M^Q \frac{\alpha_N}{\alpha_M}\right)}{\frac{\widehat{\varepsilon}_M^Q}{\alpha_M}(\alpha_N + \alpha_M - 1)}$ and $\widehat{\phi} = \frac{\widehat{\gamma}}{1+\widehat{\gamma}}$. Their respective standard errors are computed as: $(\sigma_{\widehat{\mu}})^2 = \frac{1}{(\alpha_M)^2}\left(\sigma_{\widehat{\varepsilon}_M^Q}\right)^2$, $(\sigma_{\widehat{\gamma}})^2 = \left(\frac{\alpha_M}{\alpha_N + \alpha_M - 1}\right)^2 \frac{(\widehat{\varepsilon}_M^Q)^2\left(\sigma_{\widehat{\varepsilon}_N^Q}\right)^2 - 2\,\widehat{\varepsilon}_N^Q\widehat{\varepsilon}_M^Q\left(\sigma_{\widehat{\varepsilon}_N^Q,\widehat{\varepsilon}_M^Q}\right) + (\widehat{\varepsilon}_N^Q)^2\left(\sigma_{\widehat{\varepsilon}_M^Q}\right)^2}{(\widehat{\varepsilon}_M^Q)^4}$ and $\left(\sigma_{\widehat{\phi}}\right)^2 = \frac{(\sigma_{\widehat{\gamma}})^2}{(1+\widehat{\gamma})^4}$.

we present the average price-cost mark-up that would apply if firms were to consider input prices as given prior to deciding their level of inputs as in the original Hall (1988) setting ($\widehat{\mu}$ only).

Focusing on our preferred estimator, the first-differenced OLS estimator under the assumption of constant returns to scale, ε_N^Q, ε_M^Q and ε_K^Q, are estimated at 0.298, 0.587 and 0.115 respectively.[11] The joint market imperfections parameter estimate is 0.186. The derived price-cost mark-up is found to be 1.167 and the corresponding absolute extent of rent sharing 0.440. Ignoring efficient bargaining in the labor market brings the price-cost mark-up estimate down to 1.112. Intuitively, this underestimation corresponds to the omission of the part of product rents captured by the workers. Note that for all the GMM results, none of the specification tests is passed.[12] Since, contrary to this finding, the specification tests are passed nearly everywhere in the estimates at the industry level (see below), we conclude that the rejection of the tests at the manufacturing level is consistent with imposing common slopes for the industries. Apart from being interested in industry differences per se, this finding motivates our analysis at the industry level. Note that in the dynamic specification results, the test of common factor restrictions is never passed.[13]

Comparing the results allowing for non-constant returns to scale (Part B of Table II) with those imposing constant returns to scale (Part A of Table II) leads to the following insights. The returns to scale assumption evidently affects the estimated output elasticities of factor inputs. In general, the production function coefficients are estimated to be lower when allowing for non-constant returns to scale. However, our product and labor market imperfection parameter estimates ($\widehat{\mu}$ and $\widehat{\phi}$) appear to be relatively stable when allowing for non-constant returns to scale.[14] Due to the finding of decreasing returns to scale, the average profit ratio parameter is estimated to be higher when allowing for non-constant returns to scale. Besides our objective to compare consistently estimates of product and labor market imperfections at the manufacturing, industry and firm level, we put forward a twofold motivation to maintain the constant returns to scale assumption in the remainder of the paper. *First*, since the first-order conditions with respect to the variable input factors—equation (15) for labor and equation (7) for materials—do not depend on the returns to scale assumption, our key parameters are robust to this assumption. *Second*, there is a problem of estimating simultaneously and precisely the price-cost mark-up and the elasticity of scale parameters (see Crépon *et al*., 2005).

By way of sensitivity test, we restricted the total sample to those firms for which we have 24 years of observations and estimated equation (23) imposing constant returns to scale. On average, the price-cost mark-up parameters are estimated to be higher and the corresponding extent

[11] We prefer the first-differenced OLS estimator under the assumption of constant returns to scale as this estimator allows a consistent comparison of our results at the manufacturing, industry and firm levels. Since the number of observations for each firm varies between 12 and 24, taking into account endogeneity problems in the firm estimations would lead to too much imprecision.

[12] Results are not reported but are available upon request. The validity of the instruments in the first-differenced equations is rejected by the Sargan test of overidentifying restrictions but the difference Sargan test does not reject the validity of the additional instruments in differences in the levels equations.

[13] Using $\zeta_{it} = \eta_i + u_t + \upsilon_{it}$, with $\upsilon_{it} = \rho\upsilon_{it-1} + e_{it}$ and $e_{it} \sim MA(0)$, and assuming constant returns to scale ($\lambda = 1$), we can transform equation (23) through substitution to obtain $q_{it} - k_{it} = \pi_1(q_{it-1} - k_{it-1}) + \pi_2(n_{it} - k_{it}) + \pi_3(n_{it-1} - k_{it-1}) + \pi_4(m_{it} - k_{it}) + \pi_5(m_{it-1} - k_{it-1}) + \eta_i^* + u_t^* + e_{it}$, where $\pi_1 = \rho$, $\pi_2 = \varepsilon_N^Q$, $\pi_3 = -\rho\,\varepsilon_N^Q$, $\pi_4 = \varepsilon_M^Q$, $\pi_5 = -\rho\,\varepsilon_M^Q$, $\eta_i^* = (1-\rho)\eta_i$ and $u_t^* = u_t - \rho\,u_{t-1}$. Given consistent estimates of the unrestricted parameter vector $\boldsymbol{\pi} = (\pi_1, \pi_2, \pi_3, \pi_4, \pi_5)$, the two nonlinear common factor restrictions $\pi_3 = -\pi_1\pi_2$ and $\pi_5 = -\pi_1\pi_4$ can be tested using minimum distance to get the restricted parameter vector $(\varepsilon_N^Q, \varepsilon_M^Q, \rho)$.

[14] Except for the price-cost mark-up ($\widehat{\mu}$) using the first-differenced GMM estimator, which is estimated to be much lower when allowing for non-constant returns to scale (see Part B of Table II). This result is due to the considerable decrease in the estimated output elasticity of materials ($\widehat{\varepsilon}_M^Q$) when abstaining from the constant returns to scale assumption.

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of rent-sharing parameters are estimated to be lower than those of the total (unbalanced) sample across the different estimators.[15]

4. INDUSTRY ANALYSIS

From Section 2, it follows that the joint market imperfections parameter captures (im)perfect competition in both the product and the labor market and as such determines the prevalent regime. In this section, we first classify our 38 manufacturing industries in distinct product and labor market regimes. Once the regime is determined, we derive the average industry-specific product and labor market imperfection parameters from the estimated average industry-specific joint market imperfections parameter. Within the three predominant regimes, we then provide a detailed analysis of industry differences in the estimated average parameters of interest, i.e. the output elasticities of the production function, the joint market imperfections parameter, and—depending on the regime—the price-cost mark-up and the extent of rent sharing or the labor supply elasticity parameters. To assess the plausibility of the estimated industry-specific product and labor market imperfection parameters, we tie these estimates to industry-specific observables (profitability, unionization, import penetration and technology intensity) within the dominant regime.

4.1. Classification of Industries

We consider 38 manufacturing industries, which are based on the French industrial classification (Nomenclature économique de synthèse: Niveau 3 (NES 114)), making up our sample. This decomposition is detailed enough for our purposes and ensures that each industry contains a sufficient number of firms (minimum: 104 firms; maximum: 1,000 firms). Table III presents the industry repartition of the sample and the number of firms and number of observations for each industry $j \in \{1, \ldots, 38\}$.

We apply the following classification procedure, on which we comment below.

For each industry j, we estimate the production function assuming constant returns to scale (equation (23) with $\lambda = 1$) using the first-differenced OLS estimator. In the *first part* of the classification procedure, we perform an F-test (explicit joint test) of the joint hypothesis $H_0 : (\mu_j - 1) = \psi_j = 0$, where the alternative is that at least one of the parameters (the industry-specific price-cost mark-up μ_j minus 1, or the industry-specific joint market imperfections parameter ψ_j) does not equal zero. In other words, if H_0 is not rejected, that particular industry is characterized by perfect competition in the product market and perfect competition or right-to-manage bargaining in the labor market. If H_0 is rejected, the prevalent regime $R \in \Re\backslash\{\text{PC-PR}\}$.

Having selected the industries typified by the PC-PR-regime, we test a two-dimensional hypothesis by conducting two separate t-tests to classify the remaining industries in one of the five other regimes in the *second part* of the classification procedure. For example, if our null hypothesis is that imperfect competition in the product market and efficient bargaining in the labor market feature the industry, we perform the following implicit joint test (or induced test) (Savin, 1984): $H_{10} : (\mu_j - 1) > 0$ and $H_{20} : \psi_j > 0$. The separate t-tests reject that the IC-EB regime applies if either H_{10} or H_{20} is rejected.

[15] More specifically, the price-cost mark-up is estimated at 1.319 (OLS LEV), 1.197 (OLS DIF), 1.357 (GMM DIF) and 1.359 (GMM SYS). The absolute extent of rent sharing is estimated at 0.345 (OLS LEV), 0.182 (OLS DIF), 0.481 (GMM DIF) and 0.374 (GMM SYS). In contrast to the total sample results, the Sargan test does not reject the joint validity of the lagged levels of n, m and k dated $(t-2)$ and earlier as instruments in the first-differenced equations. However, the validity of the additional first-differenced variables as instruments in the levels equations is rejected by the difference Sargan test. Results are not reported but are available upon request.

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Table III. Industry repartition

Industry j	Code	Name	No. of firms (No. of obs.)	Regime R
1	B01	Meat preparations	324 (4,881)	IC-MO
2	B02	Milk products	122 (1,981)	PC-MO*
3	B03	Beverages	106 (1,705)	PC-MO*
4	B04	Food production for animals	126 (1,942)	PC-MO*
5	B05–B06	Other food products	518 (7,835)	IC-EB
6	C11	Clothing and skin goods	453 (6,938)	IC-EB
7	C12	Leather goods and footwear	213 (3,400)	IC-EB
8	C20	Publishing, (re)printing	724 (10,919)	IC-EB
9	C31	Pharmaceutical products	130 (2,153)	PC-MO*
10	C32	Soap, perfume and maintenance products	114 (1,877)	PC-MO
11	C41	Furniture	322 (5,043)	IC-EB
12	C42, C44–C46	Accommodation equipment	179 (2,871)	IC-PR$^{\triangledown}$
13	C43	Sport articles, games and other products	156 (2,390)	IC-PR$^{\triangledown}$
14	D01	Motor vehicles	133 (2,064)	IC-PR
15	D02	Transport equipment	129 (2,177)	IC-PR$^{\triangledown}$
16	E11–E14	Ship building, aircraft and railway construction	110 (1,834)	IC-PR
17	E21	Metal products for construction	171 (2,590)	IC-EB
18	E22	Ferruginous and steam boilers	294 (4,461)	IC-EB
19	E23	Mechanical equipment	182 (3,020)	PC-MO$^{*,\triangledown}$
20	E24	Machinery for general usage	268 (4,151)	IC-PR
21	E25–E26	Agriculture machinery	154 (2,391)	PC-PR$^{\triangledown}$
22	E27–E28	Other machinery for specific usage	286 (4,355)	IC-EB
23	E31–E35	Electric and electronic machinery	203 (2,934)	IC-EB
24	F11–F12	Mineral products	205 (3,099)	IC-EB
25	F13	Glass products	104 (1,681)	PC-MO$^{\triangledown}$
26	F14	Earthenware products and construction material	391 (6,109)	IC-EB
27	F21	Textile art	270 (4,338)	IC-EB
28	F22–F23	Textile products and clothing	310 (4,858)	IC-EB
29	F31	Wooden products	475 (7,170)	IC-PR$^{\triangledown}$
30	F32–F33	Paper and printing products	330 (5,312)	IC-PR
31	F41–F42	Mineral and organic chemical products	192 (3,026)	IC-MO
32	F43–F45	Parachemical and rubber products	171 (2,759)	PC-MO*
33	F46	Transformation of plastic products	600 (9,037)	IC-EB
34	F51–F52	Steel products, non-ferrous metals	125 (2,024)	IC-PR$^{\triangledown}$
35	F53	Ironware	138 (2,247)	IC-EB
36	F54	Industrial service to metal products	1,000 (14,930)	IC-EB
37	F55–F56	Metal products, recuperation	599 (9,314)	IC-EB
38	F61–F62	Electrical goods and components	319 (5,193)	IC-PR

* Imposing $\left(\mu_j = \frac{(\varepsilon_M^Q)_j}{(\alpha_M)_j}\right) \geq 1$ and estimating a nonlinear specification switches industry $j = 2, 3, 4, 9, 19$ and 32 from PC-MO to IC-MO.

$^{\triangledown}$ Increasing the rejection regions in both parts of the classification procedure by using the 40% statistical significance level switches industry $j = 21$ from PC-PR to PC-MO, industry $j = 19$ and 25 from PC-MO to IC-MO, industry $j = 12, 13$ and 15 from IC-PR to IC-EB and industry $j = 29$ and 34 from IC-PR to IC-MO.

Since we believe that it is more likely that an industry is characterized by imperfections in either the product market or the labor market, we put *a priori* less weight on the PC-PR-regime by using the 10% statistical significance level instead of the conventional 5% level. More specifically, when testing $H_0 : (\mu_j - 1) = \psi_j = 0$ in the first part of the classification procedure, we reject H_0 at the 10% level if the two-tailed p-value is less than 0.10. When testing $H_{10} : (\mu_j - 1) = 0$ against $H_{1a} : (\mu_j - 1) > 0$ in the second part of the classification procedure, we reject H_{10} at the 10% level if $(\mu_j - 1) > 0$ and the two-tailed p-value is less than 0.20. Likewise, for the two-tailed test of ψ_j, we reject $H_{20} : \psi_j = 0$ at the 10% level if the two-tailed p-value is less than 0.10. We conducted two robustness checks, which we discuss below.

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Classification procedure: Hypothesis test	Statistical significance level	Null hypothesis not rejected
PART 1: F-test of the joint hypothesis (explicit joint test):		
$H_0: \left(\mu_j - 1 = \frac{(\varepsilon_M^Q)_j}{(\alpha_M)_j} - 1\right) = \left(\psi_j = \frac{(\varepsilon_M^Q)_j}{(\alpha_M)_j} - \frac{(\varepsilon_N^Q)_j}{(\alpha_N)_j}\right) = 0$	10%	R = PC-PR
PART 2: Two separate t-tests (implicit joint test):		
$H_{10}: \left(\mu_j - 1 = \frac{(\varepsilon_M^Q)_j}{(\alpha_M)_j} - 1\right) > 0$ and	10%	R = IC-PR
$H_{20}: \left(\psi_j = \frac{(\varepsilon_M^Q)_j}{(\alpha_M)_j} - \frac{(\varepsilon_N^Q)_j}{(\alpha_N)_j}\right) = 0$	10%	
$H_{10}: \left(\mu_j - 1 = \frac{(\varepsilon_M^Q)_j}{(\alpha_M)_j} - 1\right) = 0$ and	10%	R = PC-EB
$H_{20}: \left(\psi_j = \frac{(\varepsilon_M^Q)_j}{(\alpha_M)_j} - \frac{(\varepsilon_N^Q)_j}{(\alpha_N)_j}\right) > 0$	10%	
$H_{10}: \left(\mu_j - 1 = \frac{(\varepsilon_M^Q)_j}{(\alpha_M)_j} - 1\right) = 0$ and	10%	R = PC-MO
$H_{20}: \left(\psi_j = \frac{(\varepsilon_M^Q)_j}{(\alpha_M)_j} - \frac{(\varepsilon_N^Q)_j}{(\alpha_N)_j}\right) < 0$	10%	
$H_{10}: \left(\mu_j - 1 = \frac{(\varepsilon_M^Q)_j}{(\alpha_M)_j} - 1\right) > 0$ and	10%	R = IC-MO
$H_{20}: \left(\psi_j = \frac{(\varepsilon_M^Q)_j}{(\alpha_M)_j} - \frac{(\varepsilon_N^Q)_j}{(\alpha_N)_j}\right) < 0$	10%	
$H_{10}: \left(\mu_j - 1 = \frac{(\varepsilon_M^Q)_j}{(\alpha_M)_j} - 1\right) > 0$ and	10%	R = IC-EB
$H_{20}: \left(\psi_j = \frac{(\varepsilon_M^Q)_j}{(\alpha_M)_j} - \frac{(\varepsilon_N^Q)_j}{(\alpha_N)_j}\right) > 0$	10%	

In such a classification procedure, there might be a potential for a conflict between the explicit joint test in the first part and the implicit joint test in the second part since the rejection regions for both tests differ. We do not find any inconsistencies, except for one industry (see below).

We performed two robustness checks. *First*, we investigated how robust the main industry classification is to imposing the constraint $\left(\mu_j = \frac{(\varepsilon_M^Q)_j}{(\alpha_M)_j}\right) \geq 1$. As discussed in Section 2.3, this paper focuses on differences in product and labor market imperfection parameters and hence estimates average parameters. One could argue, however, that it is not reasonable to assume that, on average, prices fall below marginal costs over a period of 24 years. Therefore, we estimated the following nonlinear specification for each industry $j \in \{1, \ldots, 38\}$ using the first-differenced OLS estimator:

$$\begin{aligned} \mathrm{SR}_{it} &= q_{it} - \alpha_N n_{it} - \alpha_M m_{it} - [1 - \alpha_N - \alpha_M] k_{it} \\ &= \left[\frac{\varepsilon_M^Q}{\alpha_M} - 1\right]^2 [\alpha_N [n_{it} - k_{it}] + \alpha_M [m_{it} - k_{it}]] - \left[\frac{\varepsilon_M^Q}{\alpha_M} - \frac{\varepsilon_N^Q}{\alpha_N}\right] [\alpha_N [n_{it} - k_{it}]] + \zeta_{it} \end{aligned} \tag{24}$$

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Second, we tested the sensitivity of the main industry classification by increasing the rejection regions in both parts of the classification procedure. In the first part of the procedure, $H_0: (\mu_j - 1) = \psi_j = 0$ is rejected if $(\mu_j - 1, \psi_j)$ falls outside an elliptical probability contour. To check robustness, we rejected H_0 at the 40% level instead of at the 10% level. Likewise, we increased the rejection region in the second part of the procedure by decreasing the critical values of the two separate test statistics, corresponding to the 40% statistical significance level.

Table IV summarizes the industry classifications. For details on the specific industries belonging to each regime, we refer to column 5 of Table III. Focusing on the main classification, it follows that the dominant regime is IC-EB; 17 out of the 38 industries (45%) belong to this regime. This is consistent with the finding that manufacturing as a whole is characterized by IC-EB. The IC-EB-industries contain 63% of the firms. The second predominant regime is IC-PR; 10 out of the 38 industries (26%) belong to this regime. The IC-PR-industries contain 21% of the firms. The third predominant regime is PC-MO; 8 out of the 38 industries (21%) belong to this regime. The PC-MO-industries contain 10% of the firms. The IC-MO-regime only holds for 2 out of the 38 industries (5%), comprising 5% of the firms. Only one industry (3%), comprising 1% of the firms, belongs to the PC-PR-regime. Note that initially we rejected the PC-PR-regime for that particular industry (industry $j = 21$) due to a type I error in the first part of the classification procedure. Based on the two separate t-tests, however, we decided to classify this industry in the PC-PR-regime.[16] As expected, none of the industries is characterized by perfect competition in the product market and efficient bargaining in the labor market (PC-EB). On the product market side, 76% of the industries, comprising 89% of the firms, are typified by imperfect competition. On the labor market side, 45% of the industries, comprising 63% of the firms, are characterized by efficient bargaining, 29% of the industries, comprising 22% of the firms, by perfect competition or right-to-manage bargaining and monopsony features 26% of the industries, comprising 15% of the firms.

Focusing on the first robustness check, six industries switch from PC-MO to IC-MO. These industries are indicated by (*) in column 5 of Table III. As a result, the proportion of industries characterized by imperfect competition in the product market increases from 76% to 92%. Evidently, the classification of industries in one of the three labor market settings is not affected.

Focusing on the second robustness check, eight industries switch from one regime to another. These industries are indicated by (▿) in column 5 of Table III. Consequently, 82% of the industries (comprising 91% of the firms) are typified by imperfect competition on the product market side. On the labor market side, 53% of the industries (comprising 67% of the firms) are characterized by efficient bargaining, 34% of the industries (comprising 22% of the firms) by monopsony and perfect competition or right-to-manage bargaining features 13% of the industries (comprising 11% of the firms).

4.2. Industry-Level Estimates of Product and Labor Market Imperfections

The predominant regimes are IC-EB (17 industries), IC-PR (10 industries) and PC-MO (8 industries). Within each of these regimes, we investigate industry differences in the computed industry-specific factor shares $(\alpha_J)_j (J = N, M, K)$, the estimated industry-specific output elasticities $(\widehat{\varepsilon}_J^Q)_j (J = N, M, K)$, joint market imperfections parameter $\widehat{\psi}_j$, and corresponding price-cost mark-up $\widehat{\mu}_j$ (*only*) and absolute extent of rent sharing $\widehat{\phi}_j$ or labor supply elasticity $(\widehat{\varepsilon}_w^N)_j$.

Table V presents the industry mean and the industry quartile values of the first-differenced OLS results within the predominant regimes. The system GMM results are reported in Table A.I in

[16] Note that $H_{20}: \psi_j = 0$ is not rejected at the borderline (p-value of 0.13).

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Table IV. Classification of industry $j \in \{1, \ldots, 38\}$ in regime $R \in \Re = \{$PC-PR, IC-PR, PC-EB, PC-MO, IC-EB, IC-MO$\}$

Product market	Labor market			
	Perfect competition or right-to-manage bargaining (PR)	Efficient bargaining (EB)	Monopsony (MO)	
Main classification procedure (OLS DIF)				
Perfect competition (PC)				
# ind.	1	0	8	9
Prop. of ind. (%)	2.6%	0%	21.1%	23.7%
Prop. of firms (%)	1.5%	0%	9.9%	11.4%
Imperfect competition (IC)				
# ind.	10	17	2	29
Prop. of ind. (%)	26.3%	44.7%	5.3%	76.3%
Prop. of firms (%)	20.9%	62.9%	4.8%	88.6%
# ind.	11	17	10	38
Prop. of ind. (%)	29.0%	44.7%	26.3%	100%
Prop. of firms (%)	22.3%	62.9%	14.8%	100%
Robustness check 1 (OLS DIF, imposing $\mu_j \geq 1$)				
Perfect competition (PC)				
# ind.	1	0	2	3
Prop. of ind. (%)	2.6%	0%	5.3%	7.9%
Prop. of firms (%)	1.5%	0%	2.0%	3.50%
Imperfect competition (IC)				
# ind.	10	17	8	35
Prop. of ind. (%)	26.3%	44.7%	21.1%	92.1%
Prop. of firms (%)	20.9%	62.9%	12.7%	96.5%
# ind.	11	17	10	38
Prop. of ind. (%)	29.0%	44.7%	26.3%	100%
Prop. of firms (%)	22.3%	62.9%	14.8%	100%
Robustness check 2 (OLS DIF, increasing rejection regions)				
Perfect competition (PC)				
# ind.	0	0	7	7
Prop. of ind. (%)	0%	0%	18.4%	18.4%
Prop. of firms (%)	0%	0%	8.7%	8.7%
Imperfect competition (IC)				
# ind.	5	20	6	31
Prop. of ind. (%)	13.2%	52.6%	15.8%	81.6%
Prop. of firms (%)	10.9%	67.3%	13.1%	91.3%
# ind.	5	20	13	38
Prop. of ind. (%)	13.2%	52.6%	34.2%	100%
Prop. of firms (%)	10.9%	67.3%	21.8%	100%

Note: For details on the specific industries belonging to each regime: see Table III.

the Appendix. For reasons of comparability, we use the same classification of industries within regimes for both estimators (see main classification in Table IV). All the industry-specific estimates (OLS DIF and GMM SYS) are presented in Table A.II in the Appendix.[17] Tables V, A.I and A.II have the same format: the left part reports the computed factor shares, the middle part reports the output elasticity estimates and the right part reports the estimated price-cost mark-up that would apply if firms were to consider input prices as given prior to deciding their level of inputs,

[17] For reasons of completeness, Table A.II also provides detailed information on the first-differenced OLS and the system GMM estimates of the industries which are classified in the IC-MO regime (2 industries) and the PC-PR-regime (1 industry).

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the estimated joint market imperfections parameter and the derived product and labor market imperfection parameters, i.e. the price-cost mark-up taking into account labor market imperfections and the extent of rent sharing for industries within IC-EB, and the price-cost mark-up taking into account labor market imperfections and the labor supply elasticity for industries within PC-MO and IC-MO.[18] In Table A.II, the industries within the IC-EB-regime are ranked according to $\widehat{\phi}_j$. Within the IC-PR-regime, the table is drawn up in increasing order of $\widehat{\mu}_j$. Within the PC-MO-regime and the IC-MO-regime, we rank industries in increasing order of $\widehat{\beta}_j$.

From Table V, it follows that industry differences in the estimated market imperfection parameters and in the underlying estimated factor elasticities and shares are quite sizable, as could be expected. Let us focus the discussion on the primary parameters within the predominant regimes.

- Within regime R = IC-EB, $\widehat{\psi}_j$ is lower than 0.191 for industries in the first quartile and higher than 0.426 for industries in the third quartile. The corresponding $\widehat{\mu}_j$ is lower than 1.162 for the first quartile of industries and higher than 1.235 for the top quartile. The corresponding $\widehat{\phi}_j$ is lower than 0.264 for the first quartile of industries and higher than 0.398 for the top quartile. The median values of $\widehat{\mu}_j$ and $\widehat{\phi}_j$ are estimated at 1.188 and 0.363 respectively. Ignoring the occurrence of rent sharing reduces the estimated median price-cost mark-up to 1.099 ($\widehat{\mu}_j$ *only*).
- Within regime R = IC-PR, $\widehat{\mu}$ is lower than 1.081 for industries in the first quartile and higher than 1.163 for industries in the upper quartile. The median value is estimated at 1.123.
- Within R = PC-MO, we observe the highest dispersion in $\widehat{\psi}_j$ compared to the two other predominant regimes. This parameter is estimated to be lower than −0.701 for industries in the first quartile and higher than −0.342 for industries in the third quartile. Consequently, industry differences in $(\widehat{\varepsilon}_w^N)_j$ are also large. This elasticity is estimated to be lower than 1.408 for industries in the first quartile and higher than 2.973 for industries in the upper quartile. The median value of $(\widehat{\varepsilon}_w^N)_j$ is estimated at 1.711.

Taking into account endogeneity problems reveals the following patterns in the estimates (see Table A.I in the Appendix). Compared to the first-differenced OLS results, we observe a comparable degree of dispersion in the estimated joint market imperfections parameter across the three predominant regimes. However, across these three regimes we clearly discern an increase in this parameter estimate. Resolving the simultaneity bias, this increase translates into a considerably higher price-cost mark-up estimate across the three regimes, as expected.

- Within IC-EB, the estimate of the extent of rent sharing remains unchanged. The median values of $\widehat{\mu}_j$ and $\widehat{\phi}_j$ are estimated at 1.296 and 0.335 respectively (compared to 1.188 and 0.363 using the first-differenced OLS estimator).
- Within IC-PR, the median value of $\widehat{\mu}_j$ increases from 1.123 (OLS DIF) to 1.260.
- Within PC-MO, the increase in $\widehat{\psi}_j$ translates into a higher estimate of $\widehat{\beta}_j$ as well. The median value of $\widehat{\mu}_j$ increases from 0.984 to 1.132 and the median value of $\widehat{\beta}_j$ increases from 0.629 to 0.883. Besides an increase in both market imperfection parameters, we also observe a higher

[18] Dropping subscript j, $\widehat{\beta}$ and $\widehat{\varepsilon}_w^N$ are derived as follows: $\widehat{\beta} = \frac{\alpha_N}{\alpha_M}\frac{\widehat{\varepsilon}_M^Q}{\widehat{\varepsilon}_N^Q}$ and $\widehat{\varepsilon}_w^N = \frac{\widehat{\beta}}{1-\widehat{\beta}}$. Their respective standard errors are computed using the Delta method as follows: $(\sigma_{\widehat{\beta}})^2 = \left(\frac{\alpha_N}{\alpha_M}\right)^2 \frac{(\widehat{\varepsilon}_M^Q)^2\left(\sigma_{\widehat{\varepsilon}_N^Q}\right)^2 - 2\widehat{\varepsilon}_N^Q\widehat{\varepsilon}_M^Q\left(\sigma_{\widehat{\varepsilon}_N^Q,\widehat{\varepsilon}_M^Q}\right) + (\widehat{\varepsilon}_N^Q)^2\left(\sigma_{\widehat{\varepsilon}_M^Q}\right)^2}{(\widehat{\varepsilon}_N^Q)^4}$ and $\left(\sigma_{\widehat{\varepsilon}_w^N}\right)^2 = \frac{(\sigma_{\widehat{\beta}})^2}{(1-\widehat{\beta})^4}$. For the derivation of the market imperfection parameters $\widehat{\mu}$, $\widehat{\gamma}$ and $\widehat{\phi}$, and their respective standard errors, we refer to footnote 10.

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Table V. Summary industry analysis: Industry-specific output elasticities $\left(\widehat{\varepsilon}_J^Q\right)_j$ $(J = N, M, K)$, joint market imperfections parameter $\widehat{\psi}_j$, and corresponding price-cost mark-up $\widehat{\mu}_j$ (*only*) and absolute extent of rent sharing $\widehat{\phi}_j$ or labor supply elasticity $(\widehat{\varepsilon}_w^N)_j$[a,b]

Regime R = IC-EB				OLS DIF							
(17 industries)	$(\alpha_N)_j$	$(\alpha_M)_j$	$(\alpha_K)_j$	$(\widehat{\varepsilon}_N^Q)_j$	$(\widehat{\varepsilon}_M^Q)_j$	$(\widehat{\varepsilon}_K^Q)_j$	$\widehat{\mu}_j$ *only*	$\widehat{\psi}_j$	$\widehat{\mu}_j$	$\widehat{\gamma}_j$	$\widehat{\phi}_j$
Industry mean	0.334	0.488	0.178	0.295 (0.012)	0.586 (0.010)	0.119 (0.010)	1.106 (0.012)	0.319 (0.053)	1.204 (0.022)	0.526 (0.079)	0.328 (0.036)
Industry Q_1	0.294	0.470	0.165	0.264 (0.010)	0.566 (0.008)	0.103 (0.008)	1.078 (0.011)	0.191 (0.040)	1.162 (0.019)	0.359 (0.054)	0.264 (0.029)
Industry Q_2	0.333	0.482	0.177	0.286 (0.012)	0.585 (0.011)	0.118 (0.010)	1.099 (0.012)	0.315 (0.054)	1.188 (0.022)	0.569 (0.073)	0.363 (0.033)
Industry Q_3	0.379	0.513	0.187	0.316 (0.015)	0.634 (0.012)	0.137 (0.013)	1.138 (0.014)	0.426 (0.065)	1.235 (0.024)	0.661 (0.093)	0.398 (0.036)
Regime R = IC-PR											
(10 industries)	$(\alpha_N)_j$	$(\alpha_M)_j$	$(\alpha_K)_j$	$(\widehat{\varepsilon}_N^Q)_j$	$(\widehat{\varepsilon}_M^Q)_j$	$(\widehat{\varepsilon}_K^Q)_j$	$\widehat{\mu}_j$ *only*	$\widehat{\psi}_j$	$\widehat{\mu}_j$		
Industry mean	0.287	0.520	0.193	0.314 (0.017)	0.588 (0.014)	0.098 (0.013)	1.121 (0.015)	0.024 (0.080)	1.129 (0.027)		
Industry Q_1	0.257	0.496	0.170	0.287 (0.013)	0.550 (0.012)	0.083 (0.010)	1.081 (0.011)	−0.007 (0.065)	1.081 (0.022)		
Industry Q_2	0.286	0.531	0.197	0.309 (0.017)	0.577 (0.014)	0.088 (0.013)	1.116 (0.015)	0.048 (0.077)	1.123 (0.028)		
Industry Q_3	0.330	0.538	0.213	0.351 (0.020)	0.642 (0.017)	0.112 (0.017)	1.155 (0.019)	0.074 (0.085)	1.163 (0.031)		
Regime R = PC-MO											
(8 industries)	$(\alpha_N)_j$	$(\alpha_M)_j$	$(\alpha_K)_j$	$(\widehat{\varepsilon}_N^Q)_j$	$(\widehat{\varepsilon}_M^Q)_j$	$(\widehat{\varepsilon}_K^Q)_j$	$\widehat{\mu}_j$ *only*	$\widehat{\psi}_j$	$\widehat{\mu}_j$	$\widehat{\beta}_j$	$(\widehat{\varepsilon}_w^N)_j$
Industry mean	0.223	0.565	0.211	0.328 (0.022)	0.557 (0.021)	0.115 (0.017)	1.074 (0.023)	−0.556 (0.140)	0.987 (0.038)	0.659 (0.064)	2.574 (1.099)
Industry Q_1	0.160	0.508	0.195	0.264 (0.020)	0.515 (0.019)	0.098 (0.015)	1.053 (0.020)	−0.701 (0.113)	0.960 (0.035)	0.584 (0.059)	1.408 (0.370)
Industry Q_2	0.231	0.548	0.212	0.338 (0.022)	0.536 (0.021)	0.111 (0.016)	1.065 (0.024)	−0.563 (0.129)	0.984 (0.036)	0.629 (0.062)	1.711 (0.442)
Industry Q_3	0.281	0.630	0.234	0.383 (0.023)	0.603 (0.024)	0.126 (0.019)	1.101 (0.026)	−0.342 (0.166)	1.015 (0.040)	0.748 (0.069)	2.973 (1.127)

Note: Robust standard errors in parentheses.

[a] Detailed information on the industry-specific estimates is presented in Table A.II (Part A) in the Appendix.

[b] $\widehat{\psi}_j = \frac{(\widehat{\varepsilon}_M^Q)_j}{(\alpha_M)_j} - \frac{(\widehat{\varepsilon}_N^Q)_j}{(\alpha_N)_j}$ $\quad \widehat{\gamma}_j = \frac{(\widehat{\varepsilon}_N^Q)_j - \left[(\widehat{\varepsilon}_M^Q)_j \frac{(\alpha_N)_j}{(\alpha_M)_j}\right]}{\frac{(\widehat{\varepsilon}_M^Q)_j}{(\alpha_M)_j}[(\alpha_N)_j + (\alpha_M)_j - 1]}$ $\quad \widehat{\beta}_j = \frac{(\alpha_N)_j}{(\alpha_M)_j}\frac{(\widehat{\varepsilon}_M^Q)_j}{(\widehat{\varepsilon}_N^Q)_j}$

$\widehat{\mu}_j = \frac{(\widehat{\varepsilon}_M^Q)_j}{(\alpha_M)_j}$ $\quad \widehat{\phi}_j = \frac{\widehat{\gamma}_j}{1+\widehat{\gamma}_j}$ $\quad (\widehat{\varepsilon}_w^N)_j = \frac{\widehat{\beta}_j}{1-\widehat{\beta}_j}$.

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degree of dispersion in both parameters. The value of the interquartile range of $\widehat{\mu}_j$ increases from 0.055 to 0.082. For $\widehat{\beta}_j$, we identify an increase from 0.164 to 0.230.

How do our estimates of product and labor market imperfections match up with other studies? Imposing IC-EB on the data, Dobbelaere (2004) and Boulhol *et al.* (2011) examine industry differences in price-cost mark-ups and extent of rent sharing. Using a panel of 7,086 Belgian firms in 18 manufacturing industries over the period 1988–1995, Dobbelaere (2004) finds that the price-cost mark-up is lower than 1.354 for the first quartile of industries and higher than 1.500 for the upper quartile. The corresponding absolute extent of rent sharing is lower than 0.161 for the first quartile of industries and higher than 0.263 for the third quartile. Using a panel of 11,799 British firms in 20 manufacturing industries, Boulhol *et al.* (2011) estimate the price-cost mark-up to be lower than 1.212 for the bottom quartile of industries and higher than 1.292 for the top quartile. The corresponding absolute extent of rent sharing is estimated to be lower than 0.189 for the first quartile of industries and higher than 0.544 for the upper quartile. Although there is an abundant literature on estimating the extent of product market power (see Bresnahan, 1989, for a survey), there is little direct evidence of employer market power over its workers. For studies estimating the wage elasticity of the labor supply curve facing an individual employer, we refer to Reynolds (1946), Nelson (1973), Sullivan (1989), Boal (1995), Staiger *et al.* (1999), Falch (2001) and Manning (2003). These studies point to an elasticity in the [1–5] range.[19]

4.3. Different Dimensions across Industries within the IC-EB-regime

Having quantified industry differences in product and labor market imperfection parameters in the previous section, this section aims at assessing the plausibility of the industry estimates within the dominant regime (IC-EB). To this end, we tie these estimates to industry observables. We classify the 17 industries according to profitability, unionization, import penetration and technology intensity. For the first three dimensions, we consider three types (low, medium and high). For the technology dimension, we consider two types (low and medium). Columns 4–7 in Table A.III in the Appendix indicate for each dimension the type to which each industry belongs.

Figures 1–4 aim at discerning a pattern in the first-differenced OLS estimates of $\widehat{\mu}_j$ and $\widehat{\phi}_j$ within R = IC-EB. Each figure corresponds to one of the four dimensions (profitability, unionization, import penetration and technology intensity). Within each dimension, different symbols refer to different types (low, medium and high). The dashed lines denote the median values ($\widehat{\mu}_{j,\text{med}} = 1.188$, $\widehat{\phi}_{j,\text{med}} = 0.363$). Observing a positive correlation between $\widehat{\mu}_j$ and $\widehat{\phi}_j$ of 0.332, most industries are situated either in the upper right part or the lower left part of the figures.

As to the profitability dimension, we calculate the average industry-specific price-cost margin (PCM) and determine the different types based on the percentile values (low = [1–33]-percentiles, medium = [34–66]-percentiles and high = [67–100]-percentiles).[20] Following Bain (1941), many analytical and empirical studies have provided evidence of a positive relationship between market structure and performance (profitability) (see Martin, 1993 for a survey). Therefore, we expect a positive correlation between PCMs and price-cost mark-ups.

[19] For example, employing regional data, Nelson (1973) uses a population density measure to identify labor supply and reports large elasticities for most USA states. Sullivan (1989) estimates the supply elasticity of nurses directed toward individual hospitals to be in the [1.3–3.8]-range. Using data from USA coal mining, Boal (1995) finds the labor supply elasticity to be in the [1.9–6.8]-range in the short run and infinite in the long run. Staiger *et al.* (1999) point to an elasticity estimate of around 0.10, implying considerable monopsonistic wage-setting power.

[20] The price-cost margin is defined as the difference between revenue and variable cost over revenue (see Schmalensee, 1989, p. 960).

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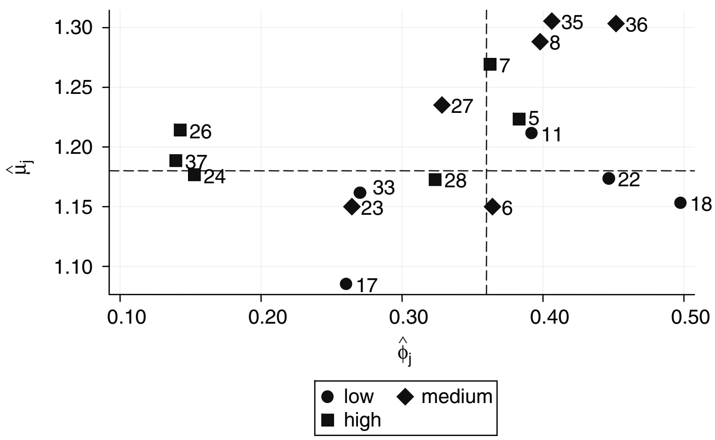

Figure 1. Profitability differences across industries within R = IC-EB. Source: Table A.II (Part A, R = IC-EB) estimates (17 industries)

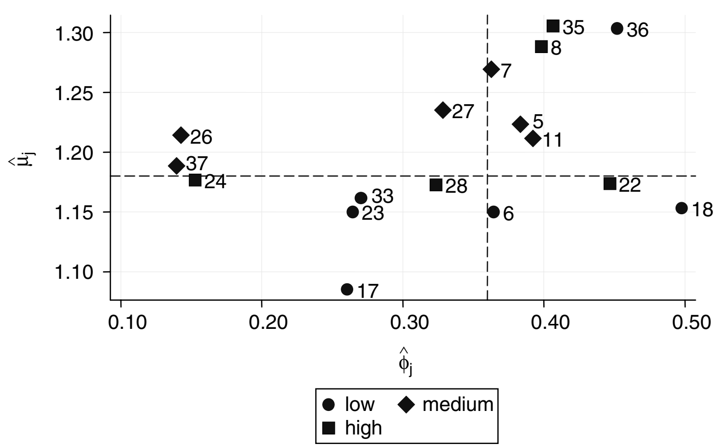

Figure 2. Unionization differences across industries within R = IC-EB. Source: Table A.II (Part A, R = IC-EB) estimates (17 industries)

- Considering the low- and high-type industries (11 out of the 17 industries), the rank correlation coefficient is 0.47 (p-value of 0.14) for $\widehat{\mu}_j$ and -0.27 (p-value of 0.43) for $\widehat{\phi}_j$.
- Figure 1 shows that for 4 out of the 6 most profitable industries $\widehat{\mu}_j > \widehat{\mu}_{j,\text{med}}$. For 4 out of the 5 least profitable industries, $\widehat{\mu}_j < \widehat{\mu}_{j,\text{med}}$. As to $\widehat{\phi}_j$, no clear pattern can be detected.

To construct our measure of the degree of unionization, we merge our original dataset consisting of firms from EAE (SESSI) with the REPONSE 1998 (Relations Professionnelles et Négociations d'Entreprises) database collected by the French Ministry of Labor. Having 911 firms left, we compute the average industry-specific union density.[21] Similar to the profitability dimension, the percentile values define the three types. According to the standard collective bargaining literature, unions are most likely created in firms where rents can be extracted. Since this is most likely to happen if there is imperfect competition in the product market, we expect a positive correlation

[21] Since we use a small non-representative subsample (only 911 firms) to define the degree of industry-specific unionization, the resulting classification has to be interpreted with caution.

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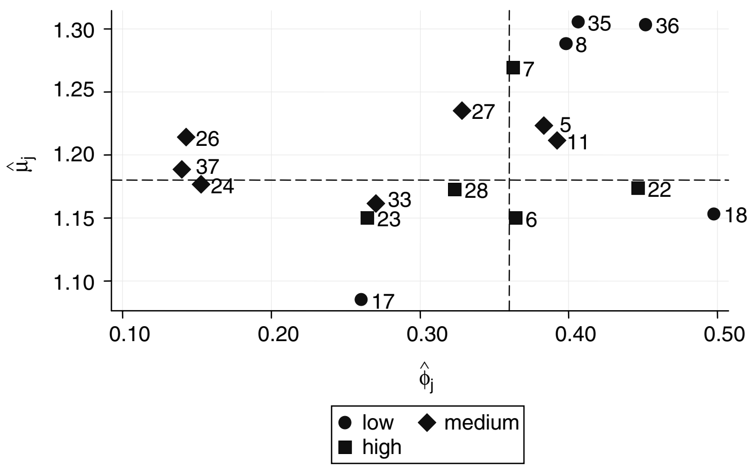

Figure 3. Openness differences across industries within R = IC-EB. Source: Table A.II (Part A, R = IC-EB) estimates (17 industries)

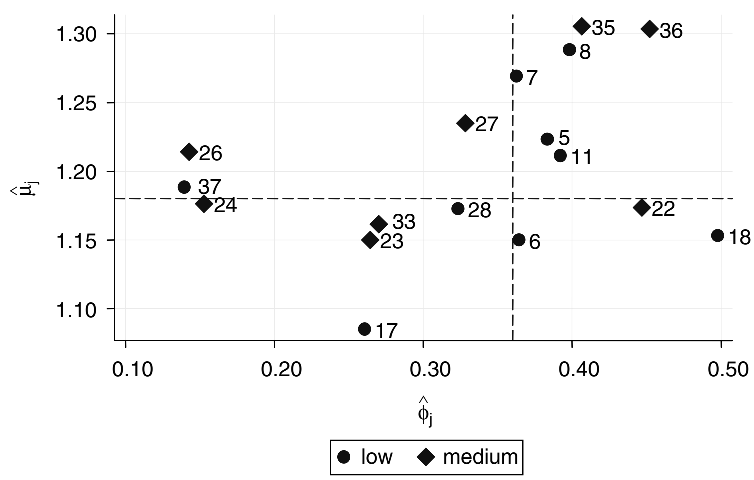

Figure 4. Technology differences across industries within R = IC-EB. Source: Table A.II (Part A, R = IC-EB) estimates (17 industries)

between union density and price-cost mark-ups. Union density is expected to be positively related to the extent of rent sharing, as shown by Karier (1985) and Conyon and Machin (1991).

- Considering the low- and high-type industries (11 out of the 17 industries), the rank correlation coefficient is 0.26 (p-value of 0.43) for $\widehat{\mu}_j$ and 0.10 (p-value of 0.76) for $\widehat{\phi}_j$.
- Figure 2 shows that for 3 out of the 5 industries with a high degree of unionization, $\widehat{\phi}_j > \widehat{\phi}_{j,\text{med}}$. For 5 out of the 6 weakly unionized industries, $\widehat{\mu}_j < \widehat{\mu}_{j,\text{med}}$. For 3 out of the 6 weakly unionized industries, $\widehat{\phi}_j < \widehat{\phi}_{j,\text{med}}$.

As to the openness dimension, we compute the average industry-specific import penetration ratio as the ratio of industry product imports to the sum of these imports plus the value of domestic production in the industry using the input–output tables defined at the three-digit level (National

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Institute for Statistics and Economic Studies (INSEE)). The different types are also identified through the percentile values. Firms under intensifying pressure from foreign competition are induced to reduce their price-cost margins because of the increase in the perceived elasticity of the demand they are facing. Following Levinsohn (1993), many studies have shown evidence of the imports-as-market-discipline hypothesis (see Boulhol *et al.*, 2011, for references). Following Rodrik's (1997) argument that the closer substitutes domestic and foreign workers are—due, for example, to international trade—the lower the enterprise surplus ending up with workers, we expect a negative correlation between import penetration and the extent of rent sharing (see also Brock and Dobbelaere, 2006; Dumont *et al.*, 2006). Using Belgian and UK firm-level data respectively, Abraham *et al.* (2009) and Boulhol *et al.* (2011) provide support for the imports-as-product-and-labor-market discipline hypothesis, i.e. they provide evidence of international competition curtailing domestic market power in the product market as well as in the labor market.

- Considering the low- and high-type industries (10 out of the 17 industries), the rank correlation coefficient is -0.41 (p-value of 0.24) for $\widehat{\mu}_j$ and -0.22 (p-value of 0.54) for $\widehat{\phi}_j$.
- Figure 3 shows that for 4 out of the 5 industries with high import penetration rates, $\widehat{\mu}_j < \widehat{\mu}_{j,\text{med}}$, while for 3 out of the 5 industries shielded from import competition, $\widehat{\phi}_j > \widehat{\phi}_{j,\text{med}}$.

The identification of the two technology types relies on the OECD classification. This methodology uses two indicators of technology intensity: R&D expenditures divided by value added and R&D expenditures divided by production (OECD, 2005). When competition intensifies, firms' reaction is not limited to pricing behavior. Sutton (1991, 1998) insists on the endogeneity of market structure. An increase in the competitive environment may trigger an endogenous reaction of firms through an increase in R&D spending, for instance. This might force out firms that are unable to keep the pace. R&D expenditures could hence be positively related to price-cost mark-ups. The correlation between technology intensity and the extent of rent sharing is *a priori* unclear. As discussed in Betcherman (1991), it depends on the importance of labor costs in the firm's total costs and on the workers' substitutability in the production process. Horn and Wolinsky (1988) follow the same argument.

- The rank correlation coefficient is -0.06 (p-value of 0.83) for $\widehat{\mu}_j$ and -0.29 (p-value of 0.25) for $\widehat{\phi}_j$.
- Figure 4 shows that for 5 out of the 8 medium-technology industries, $\widehat{\phi}_j < \widehat{\phi}_{j,\text{med}}$, whereas for 6 out of the 9 low-technology industries $\widehat{\phi}_j > \widehat{\phi}_{j,\text{med}}$.

5. FIRM ANALYSIS

Our firm analysis essentially aims at gaining insight into the production behavior of firms within industries. Indeed, production behavior is likely to vary even within industries, because input combinations differ, labor markets are not homogeneous and demand might be more elastic or inelastic in one firm compared to another. Since production is primarily affected by input factors and only secondarily by—for example—demand conditions, we assume that the relationships among variables are proper but that the production function coefficients differ across firms. Therefore, we estimate the production function assuming constant returns to scale (equation (23) with $\lambda = 1$) for each firm i using the first-differenced OLS estimator and retrieve our market imperfection parameters from the estimated firm output elasticities $[(\widehat{\varepsilon}_J^Q)_i (J = N, M, K)]$.[22] We

[22] Besides allowing for differences across firms, we could also focus on the stability of the parameters over time. However, relaxing the constancy of the joint market imperfections parameter $\widehat{\psi}_i$, and the corresponding price-cost mark-up $\widehat{\mu}_i$ and

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only consider firms for which $(\widehat{\varepsilon}_N^Q)_i$ and $(\widehat{\varepsilon}_M^Q)_i$ are estimated to be positive, ending up with 9,032 firms.[23] To guarantee consistency between the industry analysis and the firm analysis, we investigate firm differences in product and labor market imperfections conditional on the main industry classification.

We start with a brief discussion of the Swamy (1970) methodology. We then apply this methodology to analyze whether there is true firm-level dispersion in the estimated average factor elasticities and average shares, and the derived imperfection parameters within the three predominant regimes to which the industries belong (IC-EB, IC-PR and PC-MO). To assess the plausibility of the estimated firm-level product and labor market imperfection parameters, we tie these firm-level estimates to firm-specific observables within the dominant regime (IC-EB).

5.1. Swamy (1970) methodology

To determine the degree of true dispersion in the production function coefficients and market imperfection parameters, we adopt the Swamy (1970) methodology as a variance decomposition approach.[24] This method allows us to estimate the variance components in the estimated firm output elasticities $(\widehat{\varepsilon}_J^Q)_i (J = N, M, K)$, the joint market imperfections parameter $\widehat{\psi}_i$, and the corresponding price-cost mark-up $\widehat{\mu}_i$ and absolute extent of rent sharing $\widehat{\phi}_i$ or labor supply elasticity $(\widehat{\varepsilon}_w^N)_i$. In particular, the Swamy methodology enables to disentangle the pure sampling variance from the true variance.

Considering random production function coefficients that vary across firms and assuming constant returns to scale, we rewrite the production function as follows:[25]

$$\mathbf{q}_i = \mathbf{X}_i \boldsymbol{\varepsilon}_i + \boldsymbol{\xi}_i \tag{25}$$

$\boldsymbol{\varepsilon}_i$ is assumed to be randomly distributed with $\boldsymbol{\varepsilon}_i = \widetilde{\boldsymbol{\varepsilon}} + \boldsymbol{\eta}_i$. $\widetilde{\boldsymbol{\varepsilon}} = (\widetilde{\varepsilon}_1, \ldots, \widetilde{\varepsilon}_K)'$ represents the common-mean coefficient vector and $\boldsymbol{\eta}_i = (\eta_{1i}, \ldots, \eta_{Ki})'$ the individual deviation from the common mean $\widetilde{\boldsymbol{\varepsilon}}$. Following Swamy (1970), we assume that the errors for firm i are uncorrelated across firms and allow for heteroskedasticity across firms, $\boldsymbol{\xi}_i \sim N(\mathbf{0}, \sigma_i^2 I)$. $E(\boldsymbol{\eta}_i) = \mathbf{0}$, $E(\boldsymbol{\eta}_i \boldsymbol{\eta}_j') = \boldsymbol{\Delta}$ if $i = j$, $E(\boldsymbol{\eta}_i \boldsymbol{\eta}_j') = \mathbf{0}$ otherwise. Swamy suggests first estimating equation (25) for each firm i by OLS, giving:

$$\widehat{\boldsymbol{\varepsilon}}_i = (\mathbf{X}_i' \mathbf{X}_i)^{-1} \mathbf{X}_i' \mathbf{q}_i \tag{26}$$

$$\widehat{\boldsymbol{\xi}}_i = \mathbf{q}_i - \mathbf{X}_i \widehat{\boldsymbol{\varepsilon}}_i \tag{27}$$

Using equations (26) and (27), we obtain unbiased estimators of σ_i^2 $\left(\widehat{\sigma}_i^2 = \dfrac{\widehat{\boldsymbol{\xi}}_i' \, \widehat{\boldsymbol{\xi}}_i}{T - K}\right)$ and $\boldsymbol{\Delta}$ (see equation (28)). Indeed, defining the mean of $\widehat{\boldsymbol{\varepsilon}}_i$ as $\overline{\boldsymbol{\varepsilon}} = \frac{1}{N} \sum_{i=1}^{N} \widehat{\boldsymbol{\varepsilon}}_i$, their variance can be estimated

absolute extent of rent sharing $\widehat{\phi}_i$ or labor supply elasticity $(\widehat{\varepsilon}_w^N)_i$ in the time dimension would overload our already overextended computational framework.

[23] Starting from the 10,646 firm estimates, we find that $(\widehat{\varepsilon}_N^Q)_i$ is estimated to be negative in 1,481 firms and $(\widehat{\varepsilon}_M^Q)_i$ is estimated to be negative in 136 firms. Only 32% of the negatively estimated $(\widehat{\varepsilon}_N^Q)_i$ is statistically significant at the 20% level. Only 21% of the negatively estimated $(\widehat{\varepsilon}_M^Q)_i$ is statistically significant at the 20% level.

[24] For a more general treatment, we refer to Arellano and Bonhomme (2009).

[25] For the sake of parsimony, we denote the explanatory variables by $\mathbf{X}_i$ (letting $x_{1it} \equiv 1$) and the firm output elasticities by $\boldsymbol{\varepsilon}_i$.

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as

$$\widehat{\boldsymbol{\Delta}} = \frac{1}{N-1}\sum_{i=1}^{N}(\widehat{\boldsymbol{\varepsilon}}_i - \overline{\boldsymbol{\varepsilon}})(\widehat{\boldsymbol{\varepsilon}}_i - \overline{\boldsymbol{\varepsilon}})' - \frac{1}{N}\sum_{i=1}^{N}\mathrm{var}(\widehat{\boldsymbol{\varepsilon}}_i)$$

$$= \underbrace{\frac{1}{N-1}\sum_{i=1}^{N}(\widehat{\boldsymbol{\varepsilon}}_i - \overline{\boldsymbol{\varepsilon}})(\widehat{\boldsymbol{\varepsilon}}_i - \overline{\boldsymbol{\varepsilon}})'}_{(1)} - \underbrace{\frac{1}{N}\sum_{i=1}^{N}\widehat{\sigma}_i^2(\mathbf{X}_i'\mathbf{X}_i)^{-1}}_{(2)} \tag{28}$$

The logic behind the definition of $\widehat{\boldsymbol{\Delta}}$, the Swamy estimate of true variance of the coefficients, is that due to noisy estimates $(\widehat{\boldsymbol{\varepsilon}}_i)$, much of the variation in $\widehat{\boldsymbol{\varepsilon}}_i$ is not caused by *true* parameter variability but purely by sampling error. Swamy (1970) suggests correcting for this sampling variability by subtracting it off.

Two major advantages of the Swamy methodology are that these estimates are the most straightforward to obtain among the different estimators of coefficient dispersion and that they are robust to the possibility of correlated effects between the firm intercept and slope parameters and the other variables in the equation since they are based on individual regression estimates (see Mairesse and Griliches, 1990).[26]

5.2. Firm Heterogeneity in Product and Labor Market Imperfections

Do we observe sizable heterogeneity in the production behavior of firms within regimes? To gain insight into that issue, we focus on firm heterogeneity within the predominant regimes to which the industries belong (IC-EB, IC-PR and PC-MO). We only consider firms for which $(\widehat{\varepsilon}_N^Q)_i$ and $(\widehat{\varepsilon}_M^Q)_i$ are estimated to be positive, ending up with 9,032 firms. 8,459 out of these 9,032 firms belong to industries for which IC-EB, IC-PR or PC-MO holds.

Table VI summarizes the first-differenced OLS results of estimating equation (25) for each firm i. The first part of Table VI presents the estimates of firms belonging to industries for which regime R = IC-EB holds (5,715 firms). The second part presents the estimates of firms belonging to industries for which regime R = IC-PR holds (1,845 firms). The third part presents the estimates of firms belonging to industries for which regime R = PC-MO holds (899 firms). Within each regime we focus on the firm input shares, the estimated firm output elasticities, the estimated firm joint market imperfections parameter and the relevant firm product and labor market imperfection parameters.

The number of observations for each firm varies between 12 and 24. Hence, some firm-level regression estimates might be imprecise. This could lead to the conclusion that all the observed variability in the firm parameter estimates would be attributable to sampling variability and that the true variability would thus be zero. Such a conclusion, however, seems to be clearly an artifact due to outliers. Therefore, we consider two 'variants' of the *original* Swamy methodology: one based on *weighted* estimates of true dispersion and one based on *robust* estimates of true dispersion. As such, each part of Table VI is divided into three sections. The first section reports the simple mean,

[26] Besides the Swamy methodology, the random coefficient model literature suggests two other variance decomposition approaches. One approach uses the maximum likelihood (ML) estimator and the other is a more flexible approach that amounts to regressing the squares and the cross-products of residuals on comparable squares and cross-products of the independent variables (Hildreth and Houck, 1968; Amemiya, 1977; MaCurdy, 1985). Contrary to the Swamy estimates, the ML estimates and those based on the regression of the squares and cross-products of the residuals assume either independence of the firm slope parameters or independence between both the firm intercept and slope parameters and the other variables in the equation, i.e. the absence of correlated effects (for a comparison of the three different approaches, we refer to Mairesse and Griliches, 1990).

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Table VI. Summary firm analysis: Heterogeneity in firm-specific output elasticities $(\widehat{\varepsilon}_J^Q)_i (J = N, M, K)$, joint market imperfections parameter $\widehat{\psi}_i$, and corresponding price-cost mark-up $\widehat{\mu}_i$ (*only*) and absolute extent of rent sharing $\widehat{\phi}_i$ or labor supply elasticity $(\widehat{\varepsilon}_w^N)_i$. Different indicators and first-differenced OLS estimates[a,b]

Regime R = IC-EB (5,715 firms)	$(\alpha_N)_i$	$(\alpha_M)_i$	$(\alpha_K)_i$	$(\widehat{\varepsilon}_N^Q)_i$	$(\widehat{\varepsilon}_M^Q)_i$	$(\widehat{\varepsilon}_K^Q)_i$	$\widehat{\mu}_i$ *only*	$\widehat{\psi}_i$	$\widehat{\mu}_i$	$\widehat{\gamma}_i$	$\widehat{\phi}_i$
Simple mean	0.341	0.478	0.181	0.346	0.572	0.082	1.116	0.099	1.260	−2.298	0.439
Observed dispersion $\widehat{\sigma}_o$	(0.130)	(0.135)	(0.097)	(0.243)	(0.223)	(0.215)	(0.302)	(1.391)	(0.586)	(72.662)	(21.013)
True dispersion $\widehat{\sigma}_{true}$	[0.122]	[0.126]	[0]	[0.102]	[0.154]	[0.092]	[0.210]	[0.875]	[0.387]	[0]	[0]
Weighted mean	0.378	0.534	0.272	0.269	0.600	0.061	1.114	0.506	1.182	1.017	0.803
Weighted observed dispersion $\widehat{\sigma}_o$	(0.139)	(0.128)	(0.141)	(0.196)	(0.211)	(0.149)	(0.199)	(0.920)	(0.354)	(1.160)	(0.136)
Weighted true dispersion $\widehat{\sigma}_{true}$	[0.137]	[0.126]	[0.121]	[0.155]	[0.188]	[0.112]	[0.166]	[0.755]	[0.301]	[1.040]	[0.126]
Median	0.330	0.482	0.156	0.298	0.587	0.077	1.108	0.297	1.204	0.431	0.582
Interquartile observed dispersion $\widehat{\sigma}_o$	(0.128)	(0.134)	(0.089)	(0.242)	(0.232)	(0.182)	(0.239)	(1.097)	(0.435)	(1.757)	(0.440)
Robust true dispersion $\widehat{\sigma}_{true}$	[0.124]	[0.130]	[0]	[0.175]	[0.194]	[0.115]	[0.181]	[0.795]	[0.335]	[1.320]	[0.319]
Regime R = IC-PR (1,845 firms)	$(\alpha_N)_i$	$(\alpha_M)_i$	$(\alpha_K)_i$	$(\widehat{\varepsilon}_N^Q)_i$	$(\widehat{\varepsilon}_M^Q)_i$	$(\widehat{\varepsilon}_K^Q)_i$	$\widehat{\mu}_i$ *only*	$\widehat{\psi}_i$	$\widehat{\mu}_i$		
Simple mean	0.287	0.519	0.194	0.368	0.574	0.058	1.128	−0.338	1.135		
Observed dispersion $\widehat{\sigma}_o$	(0.106)	(0.119)	(0.100)	(0.252)	(0.229)	(0.221)	(0.294)	(1.580)	(0.465)		
True dispersion $\widehat{\sigma}_{true}$	[0.097]	[0.108]	[0]	[0.060]	[0.146]	[0.066]	[0.191]	[0.934]	[0.271]		
Weighted mean	0.299	0.578	0.276	0.294	0.610	0.051	1.122	0.220	1.116		
Weighted observed dispersion $\widehat{\sigma}_o$	(0.110)	(0.118)	(0.134)	(0.221)	(0.215)	(0.158)	(0.194)	(1.101)	(0.342)		
Weighted true dispersion $\widehat{\sigma}_{true}$	[0.107]	[0.116]	[0.113]	[0.172]	[0.190]	[0.117]	[0.159]	[0.889]	[0.289]		
Median	0.271	0.526	0.174	0.324	0.580	0.058	1.117	−0.008	1.122		
Interquartile observed dispersion $\widehat{\sigma}_o$	(0.105)	(0.121)	(0.091)	(0.264)	(0.243)	(0.197)	(0.242)	(1.318)	(0.407)		
Robust true dispersion $\widehat{\sigma}_{true}$	[0.099]	[0.117]	[0]	[0.186]	[0.199]	[0.127]	[0.179]	[0.954]	[0.303]		

Table VI. (*Continued*)

Regime R = PC-MO (899 firms)	$(\alpha_N)_i$	$(\alpha_M)_i$	$(\alpha_K)_i$	$(\widehat{\varepsilon}_N^Q)_i$	$(\widehat{\varepsilon}_M^Q)_i$	$(\widehat{\varepsilon}_K^Q)_i$	$\widehat{\mu}_i$ *only*	$\widehat{\psi}_i$	$\widehat{\mu}_i$	$\widehat{\beta}_i$	$(\widehat{\varepsilon}_w^N)_i$
Simple mean	0.230	0.559	0.211	0.368	0.554	0.078	1.085	−0.984	1.004	6.786	−20.307
Observed dispersion $\widehat{\sigma}_o$	(0.108)	(0.143)	(0.112)	(0.260)	(0.247)	(0.211)	(0.312)	(2.325)	(0.436)	(79.36)	(583.099)
True dispersion $\widehat{\sigma}_{true}$	[0.098]	[0.132]	[0]	[0.092]	[0.182]	[0.053]	[0.226]	[1.427]	[0.264]	[0]	[0]
Weighted mean	0.261	0.650	0.300	0.264	0.615	0.044	1.116	−0.059	1.052	0.108	0.041
Weighted observed dispersion $\widehat{\sigma}_o$	(0.108)	(0.128)	(0.136)	(0.219)	(0.259)	(0.143)	(0.190)	(1.218)	(0.319)	(0.163)	(0.208)
Weighted true dispersion $\widehat{\sigma}_{true}$	[0.105]	[0.127]	[0.120]	[0.183]	[0.241]	[0.111]	[0.162]	[1.011]	[0.278]	[0.108]	[0.151]
Median	0.219	0.563	0.185	0.322	0.557	0.059	1.085	−0.462	1.015	0.694	0.194
Interquartile observed dispersion $\widehat{\sigma}_o$	(0.116)	(0.154)	(0.109)	(0.267)	(0.287)	(0.172)	(0.247)	(1.705)	(0.401)	(0.976)	(1.786)
Robust true dispersion $\widehat{\sigma}_{true}$	[0.111]	[0.151]	[0.035]	[0.208]	[0.254]	[0.106]	[0.185]	[1.374]	[0.317]	[0.865]	[1.440]

[a] Technical details on the Swamy estimates of true variance are presented in Table A.IV in the Appendix.
[b] Formulas of the market imperfection parameter estimates are given in footnote b of Table V.

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and the corresponding observed dispersion ($\widehat{\sigma}_{\mathrm{o}}$) and original Swamy estimate of true dispersion [$\widehat{\sigma}_{\mathrm{true}}$]. The second section reports the weighted mean, and the corresponding weighted observed dispersion ($\widehat{\sigma}_{\mathrm{o}}$) and Swamy estimate of weighted true dispersion [$\widehat{\sigma}_{\mathrm{true}}$]. The third section reports the median, and the corresponding interquartile observed dispersion ($\widehat{\sigma}_{\mathrm{o}}$) and Swamy estimate of robust true dispersion [$\widehat{\sigma}_{\mathrm{true}}$].[27] Since the second variant of the original Swamy methodology is more intuitive, we focus on the *robust* estimates when discussing Table VI (see below).

Table A.IV in the Appendix—which is structured like Table VI—provides some technical details on the Swamy estimates of true dispersion. Within each regime, the first section of Table A.IV presents the *original* Swamy estimate of true variance ($\widehat{\sigma}^2_{\mathrm{true}}$, corresponding to $\widehat{\boldsymbol{\Delta}}$ in equation (28)), which is computed as the difference between the observed variance of the individually estimated firm coefficients ($\widehat{\sigma}^2_{\mathrm{o}}$, corresponding to term (1) in equation (28)) and the mean of the corresponding sampling variance ($\widehat{\sigma}^2_{s}$, corresponding to term (2) in equation (28)).[28] The Swamy estimate of the *weighted* true variance, which is calculated as the weighted observed variance minus the weighted sampling variances, is reported in the second section within each regime of Table A.IV.[29] The weight is defined as the inverse of the sampling variance. In the third section within each regime of Table A.IV, we report the Swamy estimate of the *robust* true variance, which is computed by subtracting the median of the individually estimated sampling variances from the interquartile observed variance. Each section presents an F-statistic, testing the hypothesis of equality of the estimates.[30]

How can we interpret the results reported in Table VI? Let us focus the discussion on the median values. Across the three predominant regimes, the median values of the firm-level output elasticities and the price-cost mark-up that would apply if firms were to consider input prices as given prior to deciding their level of inputs are quite comparable. The median value of $(\widehat{\varepsilon}^Q_N)_i$ lies in the [0.298–0.322]-range, the median value of $(\widehat{\varepsilon}^Q_M)_i$ lies in the [0.557–0.587]-range, the median value of $(\widehat{\varepsilon}^Q_K)_i$ lies in the [0.058–0.077]-range and the median value of $\widehat{\mu}_i$ *only* lies in the [1.085–1.105]-range. The Swamy corresponding robust estimates of true dispersion are within the [0.175–0.208]-range for $(\widehat{\varepsilon}^Q_N)_i$, within the [0.194–0.254]-range for $(\widehat{\varepsilon}^Q_M)_i$, within the [0.106–0.127]-range for $(\widehat{\varepsilon}^Q_K)_i$ and within the [0.179–0.185]-range for $\widehat{\mu}_i$ *only*.

Focusing on the relevant market imperfection parameters within each of the three predominant regime leads to the following insights.

- Within R = IC-EB, the median joint market imperfections parameter ($\widehat{\psi}_i$) is estimated at 0.297, which is close to the median value at the industry level (0.315, see Table V). The Swamy robust estimate of true dispersion amounts to 0.795, providing evidence of very sizable within-regime firm dispersion. From $\widehat{\psi}_i$, we retrieve that the median of the estimated price-cost mark-up ($\widehat{\mu}_i$)

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[27] The term *interquartile* observed dispersion indicates that the observed dispersion is computed from the interquartile range of the firm input shares and firm estimates. When focusing on the Swamy estimate of *robust* true dispersion, we assume that the individually estimated parameters are normally distributed and the sampling variance is distributed as χ^2.

[28] Taking into account the unbalanced nature of the sample, the equivalent of equation (28) for the input shares $\alpha_J\,(J = N, M, K)$ is expressed as $\widetilde{\sigma}^2_{\mathrm{true}} = 1/(N-1)\sum_{i=1}^{N}((\overline{\alpha}_J)_i - \overline{\alpha}_J)^2 - \frac{1}{\overline{T}}\,\widetilde{\sigma}^2_s$, where $\overline{T} = \sum_{n_t=12}^{24}\left(\frac{N_{n_t}}{N}n_t\right)$, $(\overline{\alpha}_J)_i = \frac{1}{\overline{T}}\sum_{t=1}^{n_t}(\alpha_J)_{it}$, $\overline{\alpha}_J = \frac{1}{N}\sum_{i=1}^{N}(\overline{\alpha}_J)_i$ and $\widetilde{\sigma}^2_s = \frac{1}{N(\overline{T}-1)}\sum_{i=1}^{N}\ \sum_{t=1}^{n_t}((\alpha_J)_{it} - (\overline{\alpha}_J)_i)^2$. n_t denotes the number of years within firm i and N_{n_t} refers to the number of firms for which we observe n_t years of observations.

[29] In practice, the weighted sampling variance is calculated as $N\ \sum_{i=1}^{N}\widehat{\sigma}^2_i$.

[30] Except for $\widehat{\gamma}_i$ and $\widehat{\phi}_i$ within IC-EB and $\widehat{\beta}_i$ and $(\widehat{\varepsilon}^N_w)_i$ within PC-MO, all the F-statistics are significant at conventional significance levels since the critical value barely exceeds 1 for our sample size. One can question, however, the validity of these F-statistics in such large samples. A more symmetric treatment of the inference problem, advocated by Leamer (1978), would necessitate using a critical value which increases with the number of degrees of freedom. This would decrease the likelihood of rejecting the hypothesis of homogeneity (Mairesse and Griliches, 1990).

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is 1.204 and the median of the estimated absolute extent of rent sharing ($\widehat{\phi}_i$) is 0.582.[31] The Swamy corresponding robust estimates of true dispersion of 0.335 and 0.319 respectively are good indicators of a credible amount of dispersion. The corresponding industry-specific median values are 1.188 for $\widehat{\mu}_j$ and 0.363 for $\widehat{\phi}_j$.

- Within $R = \text{IC-PR}$, the median of $\widehat{\psi}_i$ is -0.008 which clearly deviates from the median value of 0.048 at the industry level. Indeed, the Swamy robust estimate of true dispersion of 0.954 points to large within-regime firm differences. The median of $\widehat{\mu}_i$ is 1.122 with a Swamy corresponding robust estimate of true dispersion of 0.303. This firm median is very close to the industry median (1.123).
- Within $R = \text{PC-MO}$, the median of $\widehat{\psi}_i$ is -0.462 (compared to -0.563 at the industry level). The Swamy corresponding robust estimate of true dispersion of 1.374 illustrates the considerable amount of firm dispersion. From $\widehat{\psi}_i$, we infer that the median of $\widehat{\mu}_i$ is 1.015 and the median of $(\widehat{\varepsilon}_w^N)_i$ is 0.194. The Swamy corresponding robust estimates of true dispersion of 0.317 and 1.440 respectively give evidence of substantial within-regime firm dispersion. The industry-specific median values are 0.984 for $\widehat{\mu}_j$ and 1.711 for $(\widehat{\varepsilon}_w^N)_j$.

Inspecting the more technical details of the Swamy estimates (see Table A.IV in the Appendix) and focusing on the *original* Swamy estimates, it follows that the observed variance ($\widehat{\sigma}_o^2$) illustrates the sizable dispersion in the estimated firm output elasticities and the derived parameters. As referred to above, the dispersion at the firm level is largely magnified by large sampling errors arising from the rather short time series available. Due to the large sampling variance ($\widehat{\sigma}_s^2$), we even find zero estimates of true variance in the individually estimated relative and absolute extents of rent sharing $\widehat{\gamma}_i$ and $\widehat{\phi}_i$ within regime $R = \text{IC-EB}$ and in the individually estimated $\widehat{\beta}_i$ and labor supply elasticity $(\widehat{\varepsilon}_w^N)_i$ within regime $R = \text{PC-MO}$. In contrast, we find persistent individual firm differences in the firm input shares, the firm estimated elasticities and the derived parameters within each regime when focusing on either the Swamy estimate of the *weighted* true variance or the Swamy estimate of the *robust* true variance. For all the firm estimates, the weighted (interquartile) observed variance and—even more so—the weighted (robust) sampling variance are considerably smaller than the corresponding simple observed and simple sampling variance. As such, the Swamy estimate of the weighted (robust) true variance exceeds the corresponding Swamy estimate of the simple true variance within the three predominant regimes.

Summing up, we observe quite sizable within-regime firm dispersion in the joint market imperfections parameter and the corresponding product and labor market imperfection parameters for the three predominant regimes to which the industries belong. This statement holds even if we focus on *true* dispersion. This main finding can be interpreted in two ways. *First*, production behavior of firms within industries that are classified in the same regime is indeed truly heterogeneous. Following this interpretation, we investigate in the next section which firm-specific factors correlate with the market imperfection parameters within the dominant regime (IC-EB). *Second*, from the true dispersion of the joint market imperfections parameter, we derive that for firms within $R = \text{IC-EB}$ and $R = \text{PC-MO}$, there is room to move to another regime. Although we might expect that a majority of firms within an industry belong to the same regime as that particular industry, this presumption might be rebutted. Indeed, given that we condition the firm analysis on the industry classification, the substantial true firm dispersion might indicate that although the representative firm is characterized by the same regime as the industry to which it belongs, regime differences across firms within a given industry could be important. This calls for an extension of our analysis which we consider as a topic for future research.

[31] At the firm level, the correlation between $\widehat{\mu}_i$ *only* and $\widehat{\mu}_i$ amounts to 0.45. For 61.7% of the firms, the lack of explicit consideration of labor market imperfections results in an underestimation of the firm-specific price-cost mark-up.

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5.3. Different Dimensions across Firms within the IC-EB-regime

Similarly to the way we assess the plausibility of the industry-level estimates (see Section 4.3), we investigate how the market imperfection parameters of firms within R = IC-EB correlate with firm-specific variables like size, capital intensity, being an R&D firm and distance to the industry technology frontier.

We concentrate on the joint market imperfections parameter and the corresponding price-cost mark-up and the relative extent of rent-sharing parameters of the 5,715 firms within R = IC-EB. More specifically, the dependent variable is either the vector of $\ln(\widehat{\psi}_i)$, the vector of $\ln(\widehat{\mu}_i - 1)$ or the vector of $\ln(\widehat{\gamma}_i)$. For each of these dependent variables, we have four different matrices of regressors. Each set consists of a firm-specific variable (size, capital intensity, the R&D identifier, distance to the industry technology frontier) and industry dummies. All variables are centered around the industry mean.

Being resistant to the influence of outliers, we focus the discussion on the median regressions. For reasons of completeness, we also present the OLS and the WLS—where the weight is defined as the inverse of the sampling variance—regression coefficients of the set of regressors explaining the vector of $\ln(\widehat{\psi}_i)$, the vector of $\ln(\widehat{\mu}_i - 1)$ or the vector of $\ln(\widehat{\gamma}_i)$ in Table VII. The 0.50 quantile regression can be interpreted as a robust equivalent of OLS. The regression coefficients result from regressions with one firm-specific variable (including industry dummies), except for the regression including the R&D identifier which includes two firm-specific variables ($mixentr_i$ and $rdentr_i$) and industry dummies.

Size (n_i) is measured by the logarithm of the average number of employees in each firm. To the extent that large firms are typically multi-product firms, we might expect a positive correlation between firm size and price-cost mark-ups (Sutton, 1998). Based on the standard collective bargaining literature, firm size and the relative extent of rent-sharing parameter are expected to be positively correlated. However, we find a negative correlation between size and both $\widehat{\mu}_i$ and $\widehat{\gamma}_i$.

Capital intensity is usually included in structure-performance models to capture the difference between capital-intensive and non-capital-intensive firms. We measure this variable ($capint_i$) by the logarithm of the gross book value of fixed assets divided by sales. Since capital equipment usually constitutes sunk costs and the latter may necessitate mark-up pricing, we expect a positive correlation between capital intensity and price-cost mark-ups (see, for example, Odagiri and Yamashita, 1987). Likewise, capital intensity is expected to be positively correlated with the relative extent of rent sharing. The intuition is that if a bargaining partner receives extra income in case of a disagreement, this partner is more willing to tolerate disagreement and hence bargains for a larger share of the rents. In some studies (see, for example, Doiron, 1992), the extra income that workers receive depends on the firm's strike costs in case the negotiating parties use strikes as a dispute resolution mechanism. Among other things, higher capital intensity is shown to increase a firm's strike costs and hence to decrease its absolute extent of rent sharing (see, for example, Clark 1991, 1993; Doiron, 1992). From Table VII, it follows that capital-intensive firms are characterized by a higher $\widehat{\mu}_i$. In contrast, $\widehat{\gamma}_i$ appears to be negatively correlated with capital intensity although this result is not sensitive to running a multivariate specification.[32]

We capture technological change by an R&D variable and a measure of the distance of a firm to its industry technology frontier. To construct the R&D variable, we merge accounting information of the considered firms from EAE (SESSI) with data of Research & Development collected by DEP (Ministère de l'Education et de la Recherche). The R&D surveys (DEP) provide two R&D

[32] In particular, we ran multivariate specifications for each set of regressors where we included all firm-specific variables and industry dummies. Results are not reported but are available upon request.

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Table VII. Correlations between the joint market imperfections parameter $\ln(\widehat{\psi}_i)$, the corresponding price-cost mark-up taking into account labor market imperfections $\ln(\widehat{\mu}_i - 1)$ and relative extent of rent sharing $\ln(\widehat{\gamma}_i)$, and firm-specific observables. OLS, WLS and median regression coefficients

Regime R = IC-EB (5,715 firms)	n_i	$capint_i$	$mixentr_i$	$rdentr_i$	$dist_i$
$\hat{\beta}_{OLS}$					
$\ln(\widehat{\psi}_i)$	−0.081***	−0.013	−0.094	−0.100	0.123
	(0.021)	(0.028)	(0.074)	(0.155)	(0.064)
$\ln(\widehat{\mu}_i - 1)$	−0.108***	0.075*	−0.208**	−0.070	0.304***
	(0.020)	(0.029)	(0.072)	(0.138)	(0.061)
$\ln(\widehat{\gamma}_i)$	−0.290***	−0.138***	0.361***	−0.413**	1.208***
	(0.022)	(0.032)	(0.081)	(0.159)	(0.067)
$\hat{\beta}_{WLS}$					
$\ln(\widehat{\psi}_i)$	−0.033	−0.024	0.219	−0.064	−0.248
	(0.043)	(0.058)	(0.117)	(0.203)	(0.174)
$\ln(\widehat{\mu}_i - 1)$	−0.080**	0.127***	−0.119	−0.316**	0.309***
	(0.027)	(0.037)	(0.115)	(0.122)	(0.068)
$\ln(\widehat{\gamma}_i)$	−0.213***	−0.229***	−0.607***	−0.846***	0.947***
	(0.044)	(0.046)	(0.063)	(0.098)	(0.108)
$\hat{\beta}(0.50)$					
$\ln(\widehat{\psi}_i)$	−0.084***	0.002	−0.066	−0.038	0.089
	(0.018)	(0.028)	(0.070)	(0.146)	(0.059)
$\ln(\widehat{\mu}_i - 1)$	−0.093***	0.098***	−0.118	0.035	0.248***
	(0.017)	(0.025)	(0.066)	(0.137)	(0.073)
$\ln(\widehat{\gamma}_i)$	−0.316***	−0.153***	−0.336***	−0.352	1.181***
	(0.021)	(0.032)	(0.092)	(0.191)	(0.064)

Note: Asterisks indicate significance at *** 1% ** 5% * 10%. Robust standard errors in parentheses.
1. The dependent and the explanatory variables are centered around the industry mean.
2. The coefficients are for single firm-specific variable regressions (including industry dummies), except for the regression including the R&D identifier which includes two firm-specific variables ($mixentr_i$ and $rdentr_i$) and industry dummies.

variables: a dichotomous R&D indicator and total R&D expenditure. We assume that the sample is exhaustive, i.e. a firm that does not report any R&D expenditure is considered to be a non-R&D firm. Based on this criterion, we define three subsamples: the pure non-R&D firms, the mixed R&D firms for which we have data on R&D expenditure for less than 12 years ($mixentr_i$) and the pure R&D firms for which we have data on R&D expenditure for at least 12 years ($rdentr_i$).[33] Our measure of the average distance of a firm to its industry technology frontier is constructed as follows: $dist_i = p^{95} \ln\left(\frac{VA}{N}\right)_j - \ln\left(\frac{VA}{N}\right)_{ij}$, where i is a firm index, j an industry index and $\frac{VA}{N}$ real value added per employee. To drop outliers, we use the 95th percentile instead of the maximum. As suggested by Sutton (1991, 1998), an increase in the competitive environment might elicit an endogenous reaction of firms through an increase in R&D spending, inducing less technology-intensive firms to exit the market. Hence, we might expect a positive correlation between R&D expenditures and price-cost mark-ups. Technological change might exert an effect on the relative extent of rent sharing by affecting the nature of the production process. However, this effect is *a priori* unclear. As discussed in Horn and Wolinsky (1988) and Betcherman (1991), it depends on the importance of labor costs in the firm's total costs and on the workers' substitutability in the production process. From Table VII, it follows that firms which are further from the industry

[33] Among the 5,715 firms within R = IC-EB, 121 firms are identified as pure R&D firms, 476 as mixed R&D firms and—the complement—5,118 as pure non-R&D firms.

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technology frontier are characterized by a higher $\widehat{\mu}_i$. $\widehat{\gamma}_i$ appears to be negatively correlated with one of our technology variables ($dist_i$). The latter result is consistent with the industry analysis, which also reveals that low-technology industries seem to be typified by a higher extent of rent sharing.

6. CONCLUSION

This study starts from the belief that product and labor markets are intrinsically characterized by distortions and imperfections and from the finding that variable input factors' estimated marginal products are often larger than their measured payments. We provide two extensions of Hall's (1988) productivity econometric framework for estimating price-cost margins. The first assumes a standard collective bargaining model (efficient bargaining) between the firm and its employees, while the second abstains from the assumption that the labor supply curve facing the firm is perfectly elastic and integrates the monopsony model as an alternative to the efficient bargaining model. Both extensions identify product and labor market imperfections as two sources of discrepancies between the output contributions of individual production factors and their respective revenue shares, and they can be tested on the basis of the sign and statistical significance of a parameter of joint product and labor market imperfections.

Using an unbalanced panel of 10,646 French firms in 38 manufacturing industries over the period 1978–2001, we are able to classify these industries into six regimes depending on the type of competition in the product and the labor market. By far the most predominant regime is one of imperfect competition in the product market and efficient bargaining in the labor market (IC-EB), followed by a regime of imperfect competition in the product market and perfect competition or right-to-manage bargaining in the labor market (IC-PR), and by a regime of perfect competition in the product market and monopsony in the labor market (PC-MO). The median price-cost mark-up and absolute extent of rent-sharing parameters in the IC-EB-industries are of about 1.20 and 0.55 respectively, while the median price-cost mark-up in the IC-PR-industries is of about 1.10 and the median of the labor supply elasticity in the PC-MO-industries is of about 1.70. The random coefficient regression analyses that we perform at the firm individual level in these three predominant regimes basically confirm well these average orders of magnitude with large, yet not unreasonable, robust estimates of true dispersion (i.e. corrected for sampling dispersion). Finally, we find quite encouraging results in the two exploratory investigations of the plausibility of our findings that we could do in the case of the dominant regime (IC-EB) by relating our industry and firm-level estimates of price-cost mark-ups and extent of rent sharing to industry characteristics and firm-specific variables respectively.

Our analysis can be pursued in several directions, either to address some of its current limitations and investigate some new developments, or to adopt a more ambitious approach. We conclude by very briefly suggesting six such directions that are worth following but encounter data difficulties and/or intrinsic identification problems. The first three relate to limitations which also potentially affect many—and most—microeconometric studies of firm productivity: the fact (i) that we mostly assume in our analysis constant returns to scale, (ii) that we do not explicitly take into account the potential consequences of labor adjustment costs on our estimates of labor and product market imperfections, and (iii) that we actually estimate a revenue production function rather than an output production function for lack of firm-level output price indices. As we explained, it is intrinsically difficult to separately identify and estimate an average elasticity of scale and an average price-cost mark-up; and this difficulty is magnified when in order to control for unobserved firm individual effects the estimation is only or mainly based on the time dimension variability of the data. As we also pointed out, labor adjustment costs resulting from employment protection legislation and other

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institutional factors may account for part of the estimated wedge between labor output elasticity and share, with the effect that our estimates of the extent of rent sharing (which are indeed on the high side) could be biased upward. We tend to think that this effect should be limited, but we need to further investigate the possible bias both by using firm capacity utilization and hours of work variables, which are unavailable in our dataset, and by resorting to a dynamic specification of firm productivity changes. Not estimating *sensu stricto* a production function for lack of firm output price information can also be a cause of biases in our estimates, which has been addressed with mixed results in Crépon *et al*. (2005) following a solution suggested by Klette and Griliches (1996). The unavailability of firm-level price data is a major drawback in microeconometric studies of firm behavior, and is clearly an important avenue for current and future research.[34]

The first of the other three promising directions of research is the use of matched employer–employee data both to take into account worker (and firm) characteristics that can be observed (such as skills in particular) and to control for unobserved ones.[35] The second one is more technical; it would be to investigate further the firm heterogeneity of product and labor market imperfections within industry and regime by using latent class models versus random coefficient models, following the line of research initiated by Windmeijer (2010). Finally, the third one would be to go back to the tradition of structural modeling of firm behavior pioneered some 70 years ago by Marschak and Andrews (1944) and address frontally the formidable problems it has been continuously raising since, in spite of the formidable advances in econometrics methodology and practices.

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[34] For recent discussions and studies related to this issue, we refer to Griliches and Mairesse (1998), Melitz (2000), Mairesse and Jaumandreu (2005), Levinsohn and Melitz (2006), Foster *et al*. (2008), Katayama *et al*. (2009) and Syverson (2010).

[35] We have initiated this direction of research in Dobbelaere and Mairesse (2010), where we compare industry differences in average rent-sharing parameters based on three different approaches: the present one based on estimating a productivity equation on firm-level data, the standard one in labor econometrics based on estimating a wage equation on worker-level data, and a pure accounting approach based on measuring the firm user cost of capital and an average worker reservation wage.

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APPENDIX: DETAILED RESULTS

Table A.I. Summary industry analysis: Industry-specific output elasticities $(\widehat{\varepsilon}_J^Q)_j$ $(J = N, M, K)$, joint market imperfections parameter $\widehat{\psi}_j$, and corresponding price-cost mark-up $\widehat{\mu}_j$ (*only*) and absolute extent of rent sharing $\widehat{\phi}_j$ or labor supply elasticity $(\widehat{\varepsilon}_w^N)_j$[a,b]

Regime R = IC-EB				GMM SYS $(t-2)(t-3)$							
(17 industries)	$(\alpha_N)_j$	$(\alpha_M)_j$	$(\alpha_K)_j$	$(\widehat{\varepsilon}_N^Q)_j$	$(\widehat{\varepsilon}_M^Q)_j$	$(\widehat{\varepsilon}_K^Q)_j$	$\widehat{\mu}_j$ *only*	$\widehat{\psi}_j$	$\widehat{\mu}_j$	$\widehat{\gamma}_j$	$\widehat{\phi}_j$
Industry mean	0.334	0.488	0.178	0.316 (0.034)	0.632 (0.028)	0.052 (0.025)	1.174 (0.029)	0.350 (0.150)	1.301 (0.058)	0.501 (0.211)	0.295 (0.136)
Industry Q_1	0.294	0.470	0.165	0.264 (0.030)	0.606 (0.023)	0.022 (0.020)	1.142 (0.024)	0.221 (0.115)	1.253 (0.044)	0.311 (0.132)	0.237 (0.055)
Industry Q_2	0.333	0.482	0.177	0.314 (0.035)	0.636 (0.030)	0.047 (0.024)	1.173 (0.026)	0.354 (0.165)	1.296 (0.060)	0.503 (0.214)	0.335 (0.084)
Industry Q_3	0.379	0.513	0.187	0.359 (0.039)	0.674 (0.033)	0.075 (0.029)	1.219 (0.033)	0.443 (0.183)	1.348 (0.065)	0.685 (0.239)	0.407 (0.142)
Regime R = IC-PR											
(10 industries)	$(\alpha_N)_j$	$(\alpha_M)_j$	$(\alpha_K)_j$	$(\widehat{\varepsilon}_N^Q)_j$	$(\widehat{\varepsilon}_M^Q)_j$	$(\widehat{\varepsilon}_K^Q)_j$	$\widehat{\mu}_j$ *only*	$\widehat{\psi}_j$	$\widehat{\mu}_j$		
Industry mean	0.287	0.520	0.193	0.342 (0.036)	0.642 (0.034)	0.016 (0.029)	1.223 (0.035)	0.035 (0.176)	1.237 (0.065)		
Industry Q_1	0.257	0.496	0.170	0.301 (0.033)	0.600 (0.028)	−0.006 (0.025)	1.174 (0.030)	0.027 (0.137)	1.133 (0.053)		
Industry Q_2	0.286	0.531	0.197	0.339 (0.037)	0.649 (0.033)	0.019 (0.027)	1.234 (0.034)	0.050 (0.180)	1.260 (0.063)		
Industry Q_3	0.330	0.538	0.213	0.364 (0.042)	0.687 (0.040)	0.034 (0.034)	1.281 (0.037)	0.083 (0.207)	1.290 (0.075)		
Regime R = PC-MO											
(8 industries)	$(\alpha_N)_j$	$(\alpha_M)_j$	$(\alpha_K)_j$	$(\widehat{\varepsilon}_N^Q)_j$	$(\widehat{\varepsilon}_M^Q)_j$	$(\widehat{\varepsilon}_K^Q)_j$	$\widehat{\mu}_j$ *only*	$\widehat{\psi}_j$	$\widehat{\mu}_j$	$\widehat{\beta}_j$	$(\widehat{\varepsilon}_w^N)_j$
Industry mean	0.223	0.565	0.211	0.309 (0.041)	0.650 (0.036)	0.041 (0.038)	1.204 (0.045)	−0.273 (0.236)	1.152 (0.065)	0.835 (0.149)	4.681 (60.01)
Industry Q_1	0.160	0.508	0.195	0.264 (0.034)	0.585 (0.030)	0.008 (0.029)	1.154 (0.036)	−0.486 (0.199)	1.107 (0.055)	0.706 (0.107)	1.514 (1.796)
Industry Q_2	0.231	0.548	0.212	0.331 (0.041)	0.646 (0.037)	0.028 (0.037)	1.199 (0.040)	−0.158 (0.247)	1.132 (0.067)	0.883 (0.146)	5.308 (12.11)
Industry Q_3	0.281	0.630	0.234	0.349 (0.045)	0.715 (0.041)	0.064 (0.048)	1.247 (0.060)	−0.085 (0.268)	1.189 (0.077)	0.936 (0.170)	8.852 (116.4)

Note: First-step robust standard errors in parentheses.
[a] Detailed information on the industry-specific estimates is presented in Table A.II (Part B).
[b] Formulas of the market imperfection parameter estimates are given in footnote b of Table V.

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Table A.II. Industry analysis: Industry-specific output elasticities $(\widehat{\varepsilon}_J^Q)_j (J = N, M, K)$, joint market imperfections parameter $\widehat{\psi}_j$, and corresponding price-cost mark-up $\widehat{\mu}_j$ (*only*) and absolute extent of rent sharing $\widehat{\phi}_j$ or labor supply elasticity $(\widehat{\varepsilon}_w^N)_j$[a]

Part A: OLS DIF

Regime R = IC-EB [17 industries]								OLS DIF				
Industry j	# Firms	$(\alpha_N)_j$	$(\alpha_M)_j$	$(\alpha_K)_j$	$(\widehat{\varepsilon}_N^Q)_j$	$(\widehat{\varepsilon}_M^Q)_j$	$(\widehat{\varepsilon}_K^Q)_j$	$\widehat{\mu}_j$ *only*	$\widehat{\psi}_j$	$\widehat{\mu}_j$	$\widehat{\gamma}_j$	$\widehat{\phi}_j$
37	599	0.322	0.442	0.236	0.337 (0.010)	0.526 (0.009)	0.137 (0.008)	1.144 (0.011)	0.141 (0.045)	1.188 (0.019)	0.162 (0.049)	0.140 (0.037)
26	391	0.294	0.471	0.236	0.309 (0.012)	0.571 (0.011)	0.120 (0.010)	1.068 (0.013)	0.162 (0.061)	1.214 (0.024)	0.166 (0.060)	0.143 (0.044)
24	205	0.265	0.497	0.238	0.261 (0.016)	0.585 (0.012)	0.154 (0.014)	1.135 (0.015)	0.191 (0.075)	1.177 (0.024)	0.180 (0.068)	0.153 (0.049)
17	171	0.286	0.594	0.120	0.265 (0.016)	0.645 (0.013)	0.090 (0.014)	1.054 (0.016)	0.160 (0.072)	1.085 (0.022)	0.352 (0.153)	0.261 (0.084)
23	203	0.385	0.450	0.165	0.375 (0.018)	0.518 (0.014)	0.107 (0.016)	1.090 (0.018)	0.177 (0.069)	1.150 (0.032)	0.360 (0.132)	0.264 (0.072)
33	600	0.282	0.552	0.166	0.256 (0.008)	0.641 (0.008)	0.103 (0.007)	1.099 (0.009)	0.254 (0.040)	1.162 (0.014)	0.370 (0.054)	0.270 (0.029)
28	310	0.334	0.483	0.183	0.289 (0.012)	0.566 (0.011)	0.145 (0.010)	1.078 (0.012)	0.308 (0.054)	1.173 (0.023)	0.478 (0.075)	0.324 (0.035)
27	1,270	0.309	0.514	0.178	0.274 (0.013)	0.634 (0.011)	0.091 (0.011)	1.143 (0.012)	0.347 (0.060)	1.235 (0.022)	0.489 (0.078)	0.328 (0.035)
7	213	0.334	0.470	0.197	0.281 (0.015)	0.596 (0.013)	0.123 (0.012)	1.138 (0.015)	0.426 (0.065)	1.269 (0.027)	0.569 (0.076)	0.363 (0.031)
6	453	0.424	0.398	0.178	0.370 (0.011)	0.457 (0.008)	0.173 (0.009)	1.037 (0.011)	0.277 (0.039)	1.150 (0.020)	0.573 (0.073)	0.364 (0.029)
5	518	0.285	0.528	0.187	0.207 (0.009)	0.646 (0.011)	0.148 (0.008)	1.079 (0.011)	0.499 (0.046)	1.223 (0.020)	0.621 (0.049)	0.383 (0.018)
11	322	0.317	0.518	0.165	0.254 (0.011)	0.628 (0.011)	0.118 (0.010)	1.095 (0.012)	0.408 (0.052)	1.211 (0.022)	0.645 (0.073)	0.392 (0.027)
8	724	0.341	0.478	0.181	0.286 (0.008)	0.615 (0.008)	0.099 (0.005)	1.126 (0.007)	0.451 (0.037)	1.288 (0.016)	0.661 (0.047)	0.398 (0.017)
35	138	0.333	0.491	0.177	0.276 (0.017)	0.640 (0.016)	0.093 (0.015)	1.161 (0.018)	0.475 (0.075)	1.306 (0.033)	0.685 (0.093)	0.406 (0.033)
22	286	0.379	0.482	0.139	0.313 (0.015)	0.566 (0.011)	0.121 (0.013)	1.073 (0.014)	0.347 (0.054)	1.174 (0.022)	0.808 (0.115)	0.447 (0.035)
36	1,000	0.385	0.443	0.172	0.317 (0.007)	0.577 (0.005)	0.106 (0.005)	1.129 (0.006)	0.481 (0.027)	1.303 (0.012)	0.925 (0.039)	0.452 (0.012)
18	294	0.406	0.482	0.112	0.341 (0.011)	0.556 (0.008)	0.103 (0.010)	1.053 (0.011)	0.315 (0.040)	1.153 (0.017)	0.992 (0.114)	0.498 (0.029)
Total	6,697	0.335	0.480	0.185	0.294 (0.003)	0.584 (0.003)	0.122	1.106 (0.003)	0.341 (0.070)	1.217 (0.007)	1.123 (0.016)	0.529 (0.003)

Table A.II. (continued)

Part A: OLS DIF (continued)

Regime R = IC-PR (10 industries)								OLS DIF		
Industry j	# Firms	$(\alpha_N)_j$	$(\alpha_M)_j$	$(\alpha_K)_j$	$(\widehat{\varepsilon}_N^Q)_j$	$(\widehat{\varepsilon}_M^Q)_j$	$(\widehat{\varepsilon}_K^Q)_j$	$\widehat{\mu}_j$ *only*	$\widehat{\psi}_j$	$\widehat{\mu}_j$
20	268	0.313	0.535	0.152	0.322 (0.015)	0.574 (0.012)	0.103 (0.012)	1.063 (0.013)	0.043 (0.065)	1.073 (0.022)
29	475	0.257	0.538	0.205	0.292 (0.010)	0.579 (0.010)	0.128 (0.008)	1.090 (0.010)	−0.063 (0.053)	1.076 (0.019)
16	110	0.245	0.496	0.159	0.352 (0.021)	0.536 (0.015)	0.112 (0.018)	1.066 (0.019)	0.061 (0.082)	1.081 (0.030)
38	319	0.230	0.500	0.170	0.365 (0.013)	0.550 (0.010)	0.085 (0.010)	1.102 (0.011)	−0.007 (0.055)	1.100 (0.021)
13	156	0.322	0.465	0.213	0.323 (0.018)	0.519 (0.017)	0.158 (0.017)	1.081 (0.021)	0.111 (0.081)	1.115 (0.037)
34	125	0.218	0.569	0.213	0.279 (0.024)	0.643 (0.019)	0.078 (0.017)	1.153 (0.020)	−0.150 (0.135)	1.131 (0.033)
14	133	0.258	0.558	0.185	0.296 (0.020)	0.646 (0.017)	0.059 (0.014)	1.155 (0.017)	0.011 (0.101)	1.157 (0.031)
12	179	0.331	0.480	0.188	0.351 (0.016)	0.559 (0.014)	0.091 (0.012)	1.131 (0.015)	0.105 (0.073)	1.163 (0.029)
15	129	0.259	0.533	0.108	0.287 (0.017)	0.630 (0.014)	0.083 (0.014)	1.167 (0.016)	0.074 (0.085)	1.182 (0.026)
30	330	0.237	0.529	0.234	0.275 (0.012)	0.642 (0.012)	0.084 (0.008)	1.200 (0.011)	0.053 (0.070)	1.212 (0.022)
Total	2,224	0.282	0.520	0.198	0.309 (0.006)	0.595 (0.006)	0.096	1.136 (0.006)	0.050 (0.031)	1.144 (0.011)

Regime R = PC-MO (8 industries)								OLS DIF				
Industry j	# Firms	$(\alpha_N)_j$	$(\alpha_M)_j$	$(\alpha_K)_j$	$(\widehat{\varepsilon}_N^Q)_j$	$(\widehat{\varepsilon}_M^Q)_j$	$(\widehat{\varepsilon}_K^Q)_j$	$\widehat{\mu}_j$ *only*	$\widehat{\psi}_j$	$\widehat{\mu}_j$	$\widehat{\beta}_j$	$(\widehat{\varepsilon}_w^N)_j$
4	126	0.116	0.681	0.202	0.240 (0.022)	0.656 (0.027)	0.104 (0.017)	1.061 (0.027)	−1.099 (0.225)	0.963 (0.039)	0.457 (0.060)	0.876 (0.210)
2	122	0.137	0.693	0.170	0.234 (0.022)	0.675 (0.026)	0.092 (0.016)	1.049 (0.014)	−0.734 (0.192)	0.974 (0.037)	0.570 (0.072)	1.326 (0.391)
9	130	0.232	0.530	0.238	0.385 (0.024)	0.527 (0.022)	0.088 (0.018)	1.122 (0.025)	−0.668 (0.135)	0.994 (0.041)	0.598 (0.057)	1.489 (0.354)
3	106	0.183	0.579	0.238	0.288 (0.022)	0.549 (0.021)	0.163 (0.021)	1.027 (0.028)	−0.621 (0.140)	0.949 (0.036)	0.604 (0.060)	1.528 (0.385)
32	171	0.230	0.565	0.205	0.337 (0.021)	0.541 (0.019)	0.123 (0.015)	1.058 (0.020)	−0.505 (0.116)	0.957 (0.034)	0.654 (0.059)	1.894 (0.495)
10	114	0.250	0.531	0.219	0.339 (0.021)	0.532 (0.019)	0.129 (0.015)	1.080 (0.021)	−0.356 (0.111)	1.002 (0.036)	0.738 (0.066)	2.811 (0.959)
25	104	0.312	0.459	0.229	0.423 (0.016)	0.472 (0.022)	0.105 (0.019)	1.126 (0.025)	−0.328 (0.122)	1.028 (0.048)	0.758 (0.076)	3.136 (1.296)
19	182	0.326	0.486	0.188	0.381 (0.019)	0.502 (0.015)	0.117 (0.014)	1.070 (0.017)	−0.137 (0.082)	1.032 (0.031)	0.883 (0.065)	7.533 (4.702)
Total	1,055	0.228	0.561	0.211	0.332 (0.010)	0.553 (0.010)	0.115	1.095 (0.010)	−0.471 (0.059)	0.986 (0.018)	0.677(0.031)	2.092 (0.297)

Regime R = IC-MO (2 industries)								OLS DIF				
Industry j	# Firms	$(\alpha_N)_j$	$(\alpha_M)_j$	$(\alpha_K)_j$	$(\widehat{\varepsilon}_N^Q)_j$	$(\widehat{\varepsilon}_M^Q)_j$	$(\widehat{\varepsilon}_K^Q)_j$	$\widehat{\mu}_j$ *only*	$\widehat{\psi}_j$	$\widehat{\mu}_j$	$\widehat{\beta}_j$	$(\widehat{\varepsilon}_w^N)_j$
31	192	0.260	0.544	0.196	0.339 (0.016)	0.566 (0.015)	0.094 (0.013)	1.100 (0.016)	−0.265 (0.085)	1.041 (0.028)	0.797 (0.055)	3.935 (1.351)
1	324	0.201	0.606	0.192	0.255 (0.012)	0.638 (0.013)	0.106 (0.009)	1.090 (0.012)	−0.214 (0.080)	1.053 (0.022)	0.831 (0.055)	4.927 (1.943)
Total	516	0.221	0.585	0.194	0.285 (0.013)	0.605 (0.015)	0.110	1.122 (0.012)	0.275 (0.067)	1.203 (0.029)	1.296(0.085)	−4.374 (0.973)

Regime R = PC-PR (1 industry)								OLS DIF		
Industry j	# Firms	$(\alpha_N)_j$	$(\alpha_M)_j$	$(\alpha_K)_j$	$(\widehat{\varepsilon}_N^Q)_j$	$(\widehat{\varepsilon}_M^Q)_j$	$(\widehat{\varepsilon}_K^Q)_j$	$\widehat{\mu}_j$ *only*	$\widehat{\psi}_j$	$\widehat{\mu}_j$
21	154	0.300	0.553	0.147	0.344 (0.021)	0.556 (0.016)	0.099 (0.016)	1.037 (0.018)	−0.139 (0.093)	1.006 (0.030)

Table A.II. (continued)

Part B: GMM SYS

Regime R = IC-EB (17 industries)		GMM SYS $(t-2)(t-3)$								Sargan	$m1$	$m2$
Industry j	# Firms	$(\widehat{\varepsilon}_N^Q)_j$	$(\widehat{\varepsilon}_M^Q)_j$	$(\widehat{\varepsilon}_K^Q)_j$	$\widehat{\mu}_j$ *only*	$\widehat{\psi}_j$	$\widehat{\mu}_j$	$\widehat{\gamma}_j$	$\widehat{\phi}_j$			
37	599	0.238 (0.040)	0.692 (0.032)	0.070 (0.024)	1.243 (0.029)	0.021 (0.182)	1.564 (0.072)	0.719 (0.132)	0.418 (0.045)	0.000	−11.94	−2.24
26	391	0.252 (0.032)	0.659 (0.030)	0.088 (0.028)	1.189 (0.038)	0.066 (0.210)	1.401 (0.064)	0.482 (0.120)	0.325 (0.055)	0.015	−9.16	−2.00
24	205	0.264 (0.038)	0.623 (0.030)	0.113 (0.020)	1.174 (0.024)	0.755 (0.260)	1.253 (0.061)	0.227 (0.167)	0.185 (0.111)	1.000	−6.16	0.52
17	171	0.331 (0.049)	0.626 (0.036)	0.043 (0.029)	1.081 (0.026)	0.355 (0.337)	1.053 (0.060)	−0.238 (0.520)	−0.312 (0.894)	1.000	−6.24	0.27
23	203	0.409 (0.040)	0.563 (0.041)	0.028 (0.041)	1.162 (0.050)	0.238 (0.208)	1.249 (0.092)	0.348 (0.292)	0.258 (0.161)	1.000	−8.18	−2.72
33	600	0.298 (0.034)	0.654 (0.027)	0.047 (0.019)	1.147 (0.021)	0.875 (0.187)	1.185 (0.048)	0.180 (0.229)	0.152 (0.164)	0.000	−12.15	−2.98
28	310	0.359 (0.042)	0.626 (0.034)	0.015 (0.027)	1.227 (0.031)	0.256 (0.189)	1.296 (0.070)	0.311 (0.244)	0.237 (0.142)	0.435	−8.87	−2.96
27	1,270	0.280 (0.039)	0.674 (0.030)	0.046 (0.023)	1.193 (0.024)	0.190 (0.242)	1.312 (0.058)	0.536 (0.214)	0.349 (0.091)	0.692	−7.98	−1.73
7	213	0.359 (0.039)	0.566 (0.035)	0.075 (0.037)	1.164 (0.045)	0.286 (0.216)	1.206 (0.075)	0.183 (0.228)	0.155 (0.163)	0.999	−6.25	0.30
6	453	0.399 (0.030)	0.526 (0.017)	0.075 (0.029)	1.213 (0.033)	0.332 (0.174)	1.323 (0.043)	0.685 (0.157)	0.407 (0.055)	0.004	−9.91	−2.40
5	518	0.239 (0.016)	0.677 (0.023)	0.084 (0.022)	1.117 (0.028)	0.818 (0.175)	1.281 (0.043)	0.527 (0.086)	0.345 (0.037)	0.006	−9.15	−2.24
11	322	0.314 (0.042)	0.698 (0.034)	−0.012 (0.030)	1.247 (0.033)	0.542 (0.202)	1.348 (0.065)	0.503 (0.239)	0.335 (0.106)	0.676	−9.46	−2.81
8	724	0.295 (0.024)	0.682 (0.021)	0.023 (0.014)	1.219 (0.018)	1.079 (0.143)	1.429 (0.045)	0.746 (0.121)	0.427 (0.040)	1.000	−10.59	−0.33
35	138	0.335 (0.028)	0.668 (0.021)	−0.003 (0.022)	1.244 (0.025)	0.752 (0.246)	1.362 (0.044)	0.490 (0.147)	0.329 (0.066)	1.000	−7.18	−0.58
22	286	0.261 (0.035)	0.636 (0.025)	0.103 (0.026)	1.100 (0.027)	0.880 (0.215)	1.320 (0.052)	1.306 (0.230)	0.566 (0.043)	0.995	−9.91	2.41
36	1,000	0.372 (0.020)	0.563 (0.017)	0.065 (0.023)	1.142 (0.016)	1.051 (0.125)	1.272 (0.038)	0.537 (0.132)	0.349 (0.056)	0.000	−16.96	−3.45
18	294	0.373 (0.030)	0.606 (0.030)	0.021 (0.016)	1.104 (0.018)	0.881 (0.180)	1.258 (0.061)	0.982 (0.332)	0.495 (0.084)	0.998	−8.24	0.59
Total	6,697	0.287 (0.010)	0.676 (0.009)	0.037	1.198 (0.009)	0.551 (0.046)	1.409 (0.020)	1.326 (0.038)	0.570 (0.007)	0.000	−31.89	−3.12

Table A.II. (continued)

Part B: (continued)

Regime R = IC-PR (10 industries) — GMM SYS $(t-2)(t-3)$

Industry j	# Firms	$(\widehat{\varepsilon}_N^Q)_j$	$(\widehat{\varepsilon}_M^Q)_j$	$(\widehat{\varepsilon}_K^Q)_j$	$\widehat{\mu}_j$ *only*	$\widehat{\psi}_j$	$\widehat{\mu}_j$	Sargan	$m1$	$m2$
20	268	0.447 (0.039)	0.606 (0.040)	−0.053 (0.027)	1.222 (0.033)	0.635 (0.293)	1.133 (0.074)	0.983	−8.95	−1.79
29	475	0.301 (0.023)	0.665 (0.027)	0.034 (0.020)	1.220 (0.027)	−0.053 (0.202)	1.236 (0.050)	0.619	−11.45	−2.05
16	110	0.342 (0.042)	0.632 (0.030)	0.026 (0.034)	1.174 (0.037)	0.014 (0.246)	1.276 (0.061)	1.000	−5.89	−1.79
38	319	0.356 (0.035)	0.558 (0.038)	0.086 (0.025)	1.102 (0.031)	−0.217 (0.232)	1.116 (0.075)	0.172	−8.07	−1.86
13	156	0.406 (0.041)	0.600 (0.040)	−0.006 (0.035)	1.281 (0.046)	−0.604 (0.246)	1.290 (0.086)	1.000	−7.38	0.90
34	125	0.267 (0.034)	0.714 (0.045)	0.019 (0.037)	1.249 (0.049)	−0.198 (0.421)	1.255 (0.080)	1.000	−6.16	0.52
14	133	0.364 (0.042)	0.581 (0.037)	0.055 (0.026)	1.157 (0.030)	0.005 (0.263)	1.042 (0.066)	1.000	−6.57	−0.34
12	179	0.337 (0.033)	0.688 (0.025)	−0.025 (0.027)	1.285 (0.032)	−0.441 (0.242)	1.431 (0.052)	1.000	−7.58	−2.44
15	129	0.307 (0.043)	0.674 (0.029)	0.019 (0.033)	1.245 (0.034)	−0.072 (0.280)	1.265 (0.054)	1.000	−5.42	−1.98
30	330	0.295 (0.024)	0.703 (0.028)	0.002 (0.025)	1.295 (0.035)	0.119 (0.228)	1.328 (0.053)	0.100	−8.52	−3.32
Total	2,224	0.272 (0.015)	0.732 (0.015)	−0.004	1.253 (0.014)	0.443 (0.078)	1.408 (0.001)	0.000	−20.73	−4.68

Regime R = PC-MO (8 industries) — GMM SYS $(t-2)(t-3)$

Industry j	# Firms	$(\widehat{\varepsilon}_N^Q)_j$	$(\widehat{\varepsilon}_M^Q)_j$	$(\widehat{\varepsilon}_K^Q)_j$	$\widehat{\mu}_j$ *only*	$\widehat{\psi}_j$	$\widehat{\mu}_j$	$\widehat{\beta}_j$	$(\widehat{\varepsilon}_w^N)_j$	Sargan	$m1$	$m2$
4	126	0.217 (0.029)	0.754 (0.046)	0.028 (0.049)	1.186 (0.064)	−1.378 (0.525)	1.107 (0.067)	0.592 (0.093)	1.453 (0.562)	1.000	−2.07	−2.45
2	122	0.152 (0.035)	0.797 (0.024)	0.051 (0.027)	1.147 (0.025)	−1.307 (0.600)	1.151 (0.035)	1.034 (0.255)	−30.22 (218.1)	1.000	−4.03	−0.68
9	130	0.329 (0.046)	0.677 (0.027)	−0.005 (0.037)	1.309 (0.040)	−1.371 (0.478)	1.276 (0.051)	0.899 (0.150)	8.937 (14.78)	1.000	−4.37	−1.24
3	106	0.331 (0.044)	0.640 (0.038)	0.028 (0.052)	1.228 (0.058)	−1.033 (0.408)	1.107 (0.036)	0.612 (0.096)	1.574 (0.637)	1.000	−4.39	−1.42
32	171	0.311 (0.033)	0.611 (0.033)	0.078 (0.028)	1.162 (0.037)	−0.833 (0.315)	1.081 (0.059)	0.800 (0.118)	4.012 (2.955)	1.000	−5.28	−1.67
10	114	0.341 (0.039)	0.652 (0.037)	0.006 (0.030)	1.266 (0.036)	−0.986 (0.300)	1.228 (0.069)	0.898 (0.143)	8.768 (13.69)	1.000	−5.30	0.43
25	104	0.357 (0.053)	0.512 (0.039)	0.131 (0.048)	1.128 (0.062)	−0.509 (0.242)	1.115 (0.086)	0.973 (0.157)	36.32 (218.8)	1.000	−3.74	−1.36
19	182	0.431 (0.062)	0.559 (0.042)	0.010 (0.037)	1.211 (0.039)	−0.249 (0.259)	1.149 (0.087)	0.869 (0.182)	7.533 (10.53)	1.000	−7.77	−0.34
Total	1,055	0.224 (0.024)	0.733 (0.022)	0.043	1.223 (0.024)	0.325 (0.133)	1.307 (0.039)	1.332 (0.171)	−4.011 (1.549)	0.000	−11.58	−1.90

Table A.II. (continued)

Part B: (continued)

Regime R = IC-MO (2 industries)		GMM SYS $(t-2)(t-3)$										
Industry j	# Firms	$(\widehat{\varepsilon}_N^Q)_j$	$(\widehat{\varepsilon}_M^Q)_j$	$(\widehat{\varepsilon}_K^Q)_j$	$\widehat{\mu}_j$ *only*	$\widehat{\psi}_j$	$\widehat{\mu}_j$	$\widehat{\beta}_j$	$(\widehat{\varepsilon}_w^N)_j$	Sargan	$m1$	$m2$
1	324	0.415 (0.046)	0.576 (0.040)	0.009 (0.040)	1.014 (0.054)	−0.070 (0.263)	0.949 (0.067)	0.460 (0.074)	0.853 (0.256)	1.000	−6.84	−1.18
31	192	0.298 (0.043)	0.625 (0.053)	0.077 (0.028)	1.149 (0.036)	−0.771 (0.328)	1.149 (0.097)	1.002 (0.220)	−590.9 (76,746)	0.972	−5.66	−1.08
Total	516	0.370 (0.036)	0.688 (0.031)	−0.058	1.314 (0.036)	0.275 (0.067)	1.369 (0.061)	1.135 (0.148)	−8.422 (8.168)	0.966	−7.77	0.75

Regime R = PC-PR (1 industry)		GMM SYS $(t-2)(t-3)$								
Industry j	# Firms	$(\widehat{\varepsilon}_N^Q)_j$	$(\widehat{\varepsilon}_M^Q)_j$	$(\widehat{\varepsilon}_K^Q)_j$	$\widehat{\mu}_j$ *only*	$\widehat{\psi}_j$	$\widehat{\mu}_j$	Sargan	$m1$	$m2$
21	154	0.356 (0.047)	0.647 (0.042)	−0.003 (0.030)	1.175 (0.035)	−0.632 (0.333)	1.170 (0.076)	1.000	−6.88	−0.27

Note: Robust standard errors (OLS DIF) and first-step robust standard errors (GMM SYS) in parentheses. Time dummies are included but not reported.
[a] Formulas of the market imperfection parameter estimates are given in footnote b of Table V.
1. GMM SYS: the set of instruments includes the lagged levels of n, m and k dated $(t-2)$ and $(t-3)$ in the first-differenced equations and the lagged first-differences of n, m and k dated $(t-1)$ in the levels equations.
2. Sargan: test of overidentifying restrictions, asymptotically distributed as χ^2_{df}. p-values are reported.
3. $m1$ and $m2$: tests for first-order and second-order serial correlation in the first-differenced residuals, asymptotically distributed as $N(0,1)$.

Table A.III. Different dimensions across industries within R = IC-EB

Industry j	Code	Name	Profit.[a] type	Union.[b] type	Imp.[c] type	Tech.[d] type
5	B05–B06	Other food products	H	M	M	L
6	C11	Clothing and skin goods	M	L	H	L
7	C12	Leather goods and footwear	H	M	H	L
8	C20	Publishing, (re)printing	M	H	L	L
11	C41	Furniture	L	M	M	L
17	E21	Metal products for construction	L	L	L	L
18	E22	Ferruginous and steam boilers	L	L	L	L
22	E27–E28	Other machinery for specific usage	L	H	H	M
23	E31–E35	Electric and electronic machinery	M	L	H	M
24	F11–F12	Mineral products	H	H	M	M
26	F14	Earthenware products and construction material	H	M	M	M
27	F21	Textile art	M	M	M	M
28	F22–F23	Textile products and clothing	H	H	H	L
33	F46	Transformation of plastic products	L	L	H	M
35	F53	Ironware	M	H	L	M
36	F54	Industrial service to metal products	M	L	L	M
37	F55–F56	Metal products, recuperation	H	M	M	L

Note: L: low type; M: medium type; H: high type.
[a] L: PCM $<$ 16.8% (5 industries); M: 16.8% $\leq$ PCM $<$ 17.7% (6 industries); H: PCM $\geq$ 17.7% (6 industries).
[b] L: union density $<$ 8.8% (6 industries); M: 8.8% $\leq$ union density $<$ 12.1% (6 industries); H: union density $\geq$ 12.1% (5 industries).
[c] L: import penetration $<$ 0.19 (5 industries); M: 0.19 $\leq$ import penetration $<$ 0.34 (7 industries); H: import penetration $\geq$ 0.34 (5 industries).
[d] L (9 industries); M (8 industries).

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Table A.IV. Firm analysis: Heterogeneity in firm-specific output elasticities $(\widehat{\varepsilon}_J^Q)_i (J = N, M, K)$, joint market imperfections parameter $\widehat{\psi}_i$, and corresponding price-cost mark-up $\widehat{\mu}_i$ (*only*) and absolute extent of rent sharing $\widehat{\phi}_i$ or labor supply elasticity $(\widehat{\varepsilon}_w^N)_i$. Different indicators and first-differenced OLS estimates[a]

Regime R = IC-EB (5,715 firms)	$(\alpha_N)_i$	$(\alpha_M)_i$	$(\alpha_K)_i$	$(\widehat{\varepsilon}_N^Q)_i$	$(\widehat{\varepsilon}_M^Q)_i$	$(\widehat{\varepsilon}_K^Q)_i$	$\widehat{\mu}_i$ *only*	$\widehat{\psi}_i$	$\widehat{\mu}_i$	$\widehat{\gamma}_i$	$\widehat{\phi}_i$
Simple											
Observed variance $\widehat{\sigma}_o^2$	0.017	0.018	0.009	0.059	0.050	0.046	0.091	1.936	0.343	5,279	441.53
Sampling variance $\widehat{\sigma}_s^2$	0.002	0.002	0.029	0.049	0.026	0.038	0.047	1.169	0.193	$1.57\,10^9$	$2.83\,10^9$
True variance $\widehat{\sigma}_{true}^2$ [b]	0.015	0.016	0	0.010	0.024	0.008	0.044	0.766	0.150	0	0
F-test[c]	9.039	7.523	0.331	1.212	1.907	1.225	1.941	1.655	1.774	$3.37\,10^{-6}$	$1.56\,10^{-7}$
Weighted											
Weighted observed variance $\widehat{\sigma}_o^2$	0.019	0.016	0.020	0.038	0.044	0.022	0.039	0.847	0.125	1.347	0.018
Weighted sampling variance $\widehat{\sigma}_s^2$	$5.80\,10^{-4}$	$5.10\,10^{-4}$	0.005	0.014	0.009	0.010	0.012	0.277	0.035	0.264	0.003
Weighted true variance $\widehat{\sigma}_{true}^2$ [b]	0.019	0.016	0.015	0.024	0.035	0.013	0.027	0.570	0.090	1.083	0.016
F-test[c]	33.27	32.11	3.75	2.656	4.800	2.314	3.276	3.059	3.593	5.103	6.648
Median											
Interquartile observed variance $\widehat{\sigma}_o^2$	0.016	0.018	0.008	0.058	0.054	0.033	0.057	1.203	0.189	3.089	0.194
Robust sampling variance $\widehat{\sigma}_s^2$	0.001	0.001	0.013	0.028	0.016	0.020	0.024	0.571	0.077	1.347	0.092
Robust true variance $\widehat{\sigma}_{true}^2$ [b]	0.015	0.017	0	0.031	0.038	0.013	0.033	0.631	0.112	1.742	0.101
F-test[c]	16.28	18.17	0.606	2.106	3.288	1.665	2.330	2.105	2.456	2.293	2.104
Regime R = IC-PR (1,845 firms)	$(\alpha_N)_i$	$(\alpha_M)_i$	$(\alpha_K)_i$	$(\widehat{\varepsilon}_N^Q)_i$	$(\widehat{\varepsilon}_M^Q)_i$	$(\widehat{\varepsilon}_K^Q)_i$	$\widehat{\mu}_i$ *only*	$\widehat{\psi}_i$	$\widehat{\mu}_i$		
Simple											
Observed variance $\widehat{\sigma}_o^2$	0.011	0.014	0.010	0.064	0.052	0.049	0.086	2.497	0.216		
Sampling variance $\widehat{\sigma}_s^2$	0.002	0.003	0.025	0.060	0.031	0.044	0.050	1.625	0.143		
True variance $\widehat{\sigma}_{true}^2$ [b]	0.009	0.012	0	0.003	0.021	0.004	0.036	0.873	0.073		
F-test[c]	6.184	5.262	0.394	1.059	1.695	1.098	1.729	1.537	1.512		
Weighted											
Weighted observed variance $\widehat{\sigma}_o^2$	0.012	0.014	0.018	0.049	0.046	0.025	0.038	1.212	0.117		
Weighted sampling variance $\widehat{\sigma}_s^2$	$6.40\,10^{-4}$	$4.97\,10^{-4}$	0.005	0.019	0.010	0.011	0.012	0.421	0.033		
Weighted true variance $\widehat{\sigma}_{true}^2$ [b]	0.011	0.013	0.013	0.030	0.036	0.014	0.025	0.791	0.084		
F-test[c]	18.76	27.92	3.444	2.554	4.514	2.231	3.032	2.879	3.509		
Median											
Interquartile observed variance $\widehat{\sigma}_o^2$	0.011	0.015	0.008	0.069	0.059	0.039	0.058	1.736	0.166		
Robust sampling variance $\widehat{\sigma}_s^2$	0.001	$9.38\,10^{-4}$	0.012	0.035	0.019	0.023	0.026	0.825	0.074		
Robust true variance $\widehat{\sigma}_{true}^2$ [b]	0.010	0.014	0	0.035	0.039	0.016	0.032	0.911	0.092		
F-test[c]	9.696	15.65	0.685	1.996	3.045	1.699	2.206	2.104	2.240		

Table A.IV. (continued)

Regime R = PC-MO (899 firms)	$(\alpha_N)_i$	$(\alpha_M)_i$	$(\alpha_K)_i$	$(\widehat{\varepsilon}^Q_N)_i$	$(\widehat{\varepsilon}^Q_M)_i$	$(\widehat{\varepsilon}^Q_K)_i$	$\widehat{\mu}_i$ *only*	$\widehat{\psi}_i$	$\widehat{\mu}_i$	$\widehat{\beta}_i$	$(\widehat{\varepsilon}^N_w)_i$
Simple											
Observed variance $\widehat{\sigma}^2_o$	0.012	0.020	0.012	0.067	0.061	0.045	0.097	5.405	0.190	6,299	$34\,10^4$
Sampling variance $\widehat{\sigma}^2_s$	0.002	0.003	0.019	0.059	0.028	0.042	0.046	3.369	0.120	$4.74\,10^{10}$	$5.89\,10^{13}$
True variance $\widehat{\sigma}^2_{true}$ [b]	0.010	0.017	0	0.008	0.033	0.003	0.051	2.036	0.069	0	0
F-test[c]	5.716	6.974	0.655	1.145	2.192	1.066	2.114	1.604	1.578	$1.33\,10^{-7}$	$5.77\,10^{-9}$
Weighted											
Weighted observed variance $\widehat{\sigma}^2_o$	0.012	0.016	0.018	0.048	0.067	0.020	0.036	1.483	0.102	0.027	0.043
Weighted sampling variance $\widehat{\sigma}^2_s$	$6.30\,10^{-4}$	$3.79\,10^{-4}$	0.004	0.014	0.009	0.008	0.010	0.461	0.025	0.015	0.020
Weighted true variance $\widehat{\sigma}^2_{true}$ [b]	0.011	0.016	0.014	0.033	0.058	0.012	0.026	1.022	0.077	0.012	0.023
F-test[c]	18.63	43.42	4.582	3.294	7.367	2.487	3.737	3.215	4.117	1.793	2.125
Median											
Interquartile observed variance $\widehat{\sigma}^2_o$	0.013	0.024	0.012	0.071	0.082	0.029	0.061	2.907	0.161	0.952	3.191
Robust sampling variance $\widehat{\sigma}^2_s$	0.001	$9.36\,10^{-4}$	0.011	0.028	0.017	0.018	0.026	1.019	0.060	0.204	1.116
Robust true variance $\widehat{\sigma}^2_{true}$ [b]	0.012	0.023	0.001	0.043	0.065	0.011	0.034	1.887	0.100	0.748	2.074
F-test[c]	12.31	25.38	1.116	2.526	4.691	1.609	2.294	2.852	2.669	4.668	2.857

[a] Formulas of the market imperfection parameter estimates are given in footnote b of Table V.
[b] The estimated true variance is computed by adjusting the observed variance for the sampling variability: $\widehat{\sigma}^2_{true} = \widehat{\sigma}^2_o - \widehat{\sigma}^2_s$.
[c] F-test $= \frac{\widehat{\sigma}^2_o}{\widehat{\sigma}^2_s}$: F-statistic for the hypothesis of equality of the estimates (or the computed variables) across firms.